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The Season's Greetings

IN HARMONY with the spirit of the season and with a sincerity borne of a deep appreciation of the support and encouragement which the Engineering Record has received from subscribers and advertisers, we wish you a Merry Christmas and a Happy New Year—a new year that in spiritual and material progress will surpass all that have gone before, and in extending this greeting we cannot but express the earnest hope, in which we know that every reader will join, that the coming year may see the termination of the terrible slaughter that is devastating Europe and making a mockery of our civilization. If the next holiday season finds the world enjoying peace—a peace that will have some semblance of permanence by reason of international guarantees—then indeed will it be considered a truly festive season.

Longest Simple Span Swung

WITH the successful erection of the longest simple trusses in the world, at Metropolis, Ill., when the 720-ft. span of the Paducah & Illinois Railroad bridge over the Ohio River was swung on Dec. 11, another engineering record is set. Many of the details used in erecting this span are of special interest; they are described on page 774. To eliminate as far as possible the high secondary stresses in the main members due to the use of subpanels, the main members were forced out of line during erection an amount computed to allow for the elongation of the members in the secondary triangles and produce straight end posts and diagonals under dead load plus one-half uniform live load. This loading was taken as the camber loading for which the lower chord would be a straight line. Of special interest, because of the second Quebec Bridge accident, is the detail of a phosphor-bronze bearing block which allows free rotation in two directions at right angles to each other. Instead of a double-pin rocker casting, a compact bearing block with perpendicular cylindrical bearing surfaces was adopted. In view of the expressed determination of the builders of the Quebec Bridge to change the details of the rockers, the successful erection of this record-breaking span on a compact bearing block of phosphor bronze is at least suggestive.

Guessing at Road Costs

HASTY, inaccurate guesses at road costs caused a great deal of trouble in Virginia a few years ago. County officials designated a large mileage of roads for improvement, guessed at the cost, and then persuaded the taxpayers to vote bonds for the construction. The results of such a policy have been set forth convincingly by the American Highway Association. When the people had committed themselves to considerable debts on promises of definite systems of good roads, engineers were at last called into the business. They reported that the roads could not be built for the money provided, particularly where considerable grading was necessary and comparatively expensive types of construction were proposed. This caused so much dissatisfaction and aroused such opposition to road improvements that the Virginia Legislature had to pass laws to regulate such affairs, which require a proper estimate of the cost of roads to be made before bonds are issued to pay for them. As a matter of fact, there should be a law in every State requiring an examination and estimate by a competent person of any proposed road improvements costing more than $500 per mile before such work is undertaken. There is an enormous waste of money on roads every year, due to undertaking more than there are funds to pay for, and, when this is discovered, spending the remaining money is silly scratching of the ground to make a mere temporary change in conditions, which the first hard rain will ruin.

Damages for Extraordinary Traffic

WHAT is "ordinary" traffic for highways in one locality may be "extraordinary" in another, according to the recent decision of an English court which awarded the Abingdon Rural District Council £350 as expenses incurred for repairs to one of its roads damaged by the excessive weight and extraordinary traffic of motor omnibuses belonging to the City of Oxford Electric Tramways, Ltd. The case, according to defendant's counsel, is the first in which liability has been claimed on the ground that the motorbus traffic is extraordinary. In view of the movement for legislation regulating weights and speeds of motor vehicles in the United States, the case is decidedly timely. If it should be regarded as a precedent, some very interesting results would follow. In giving judgment, Mr. Justice Sankey said that whether a particular traffic is extraordinary or not must be a pure question of fact in each case. Nor did he hold that the need of motorbus service should relieve the defendant from responsibility. The Court was unable to see how the demand of a district for traffic which was extraordinary could turn that traffic into ordinary traffic, although it might be necessary. In the case of the Strand, he pointed out, heavy motor traffic could not be placed in the category of extraordinary. At certain hearings on motortruck bills in this country recently the argument has been advanced that state highways and city streets should be built strong enough to carry any traffic that may be imposed upon them. This is an extreme position to take and one which fails to recognize that millions of dollars have been spent on existing roads which cannot be reconstructed at once to meet traffic demands for which they were never designed. This investment must be protected, and the only method of doing it is to restrict the weight, size and speed of motor vehicles or to make the motor-vehicle owners pay, either directly or by taxation, for the damage they do. These principles, obviously, form the basis of the award of damage in the Abingdon case.

Chicago Traction Plan

THE digestion of a $250,000 engineering commission's report at one meal is really more than Chicago newspapers—and their readers—ought to attempt. It is perhaps as well, therefore, that the general plans from the report of the Chicago Traction and Subway Commission should have been given out before the details were in shape. As it has turned out the general plan is none too well digested even yet. Although pages have been printed, none of the editorial writers seems to have sensed the fact that it is one of the biggest projects that the city has ever considered. There are four important fundamental features. The first is the assumption that all of the traction facilities will be unified. The next is the proposal to revamp the present elevated lines into a real rapid transit system. This carries with it the definite separation of the long and short haul traffic, utilizing the surface lines as feeders for the long haul rapid transit. The third important feature is the "pulling out" of the loop in all directions to alleviate the congested business district girdled with the present iron band. Lastly, there is a provision for through rapid transit between the northwest and southwest sides of the city without the necessity for detouring through the central business district. The plan will eliminate the present condition by which thirteen tracks on the elevated lines focus on two tracks in the loop. So far no one has suggested that the meal is not worth the price.

Proving Their Own Case

SIX years ago, when the California highway bond issue was regarded rather doubtfully, advocates of good roads by dint of hard work just managed to secure a slight majority of votes in favor of the $18,000,000 for launching the construction of a system of highways. Such changes as have taken place since then may be considered as being due directly to the improvements resulting from the expenditure of the first bond issue. In 1916 there came up again the question of another appropriation, this time for $15,000,000, with which to complete and extend the road system. The interest lies in the comparison of the voting in these two elections six years apart. During this time the real meaning of the good roads movement has been brought home to the people. Just what the effect has been is shown by the following facts: There are fifty-eight counties in the State; in 1910 fourteen, including the one with the largest number of votes, voted against the highway bond measure and the measure carried by the close margin of 93,297 for and 80,509 against. In the 1916 election every county voted for the measure and in no county was the plurality less than 2 to 1. In one case it was 19.97 to 1. Two counties, each of which voted about 4 to 1 against the bonds in 1910, voted practically 3 to 1 in favor of the 1916 issue. For the entire State the plurality favorable to the issue at the recent election was 405,132 out of a total number of votes on this issue of 679,346.

The Christmas Spirit

THE spirit of the season permits—yes, it even invites—a departure from the formalism of business and professional procedure. All men are friends to-day. The relation of seller and buyer, of counsel and client, even of employer and employee, becomes hazy. A spirit of good will throws the formal relations into the background.

And who would have it otherwise? Are not the human qualities, after all, the ones that some day must dominate all intercourses between men? In the last analysis it is because of the divorcement from business of the finer sentiments that control us in our home and neighborhood life that there is derangement in society.

When industry and trade were carried on in small units, the owner took a paternal interest in his people. Their welfare was his concern. He was an adviser, a consoler. He was interested in their mode of life, he was anxious that they should progress in the possession of worldly goods. Factory standards were lower, it is true, but the lack of data, not the attitude of the employer, was at fault. With the development of industry the owner could not continue to have an interest in each employee. Moreover—and here is where the employer was at fault—he did not, as a substitute, create machinery to give consideration to the human factor. The views of less far-seeing men set the labor policies. Competition came and with it the demand for lower costs. The less far-seeing men again controlling, it was believed that high wages were incompatible with low costs, and wages were either forced down or low grade men were employed. The attendant ills of bad housing, of poorly nourished children, of child and woman's labor followed.

Fortunately we are getting beyond this stage of industrial development. Industries are creating machinery—in the shape of intelligent employment bureaus, of welfare departments, of savings and home building funds, of educational bureaus—that is looking after the human side and where industry, as a whole, is flagrantly backward the law, backed by enlightened public opinion, is stepping in and forcing good sanitary conditions, safety measures, and workmen's compensation for industrial accidents.

But have we wandered far from our text—the Christmas spirit? No, for the wider spreading of that spirit through business and industry is an augury of yet greater "humanizing" of our industrial life, of a time when human consideration will go side by side with economics and trade promotion methods in determining business policies.

Snow-Fighting Methods Prove Their Worth in New York

WHEN such hostile critics as the New York daily papers commend the work of the Department of Street Cleaning for the prompt removal of a heavy fall of snow such as blanketed the city's streets last Friday, it is safe to assume that a task little short of miraculous has been performed. As a matter of fact, this is exactly what has happened. Until this year Commissioner Fetherston's reorganization of the work of snow removal on a basis of efficiency was a target for sarcastic comment. It was too revolutionary to suit the editorial writers, who, ignoring the evidence of comparative records of work done in the old and the new way, longed for the "good old days" when the job of clearing the city's streets was intrusted to a "practical" man instead of to a commissioner with engineering training and a lot of new-fangled ideas. Commissioner Fetherston was ahead of his time when he inaugurated snow-fighting methods in 1914. Public opinion is now catching up with him. It is reflected in an editorial in the New York *Times*, which contains such appreciations as these: "No such prompt, energetic and effectual battler with snow as Mr. Fetherston. . . . It was great work. . . . One of the best parts of the municipal administration."

Last week's storm, 12 in. of snow in 15 hours, put a heavy burden upon the Street Cleaning Department, which has scheduled the enormous area of 30,000,000 sq. yd. of street surface for snow removal—equivalent to a 60 ft. roadway between New York and Chicago. Nevertheless, it demonstrated the effectiveness of the new snow-fighting system under which the attack is begun with a large force of emergency workers, in addition to the regular department employees, while the storm is still in progress.

Three factors contributed to the success of this season's first work. In the first place, there was an unexpectedly large response to the call for emergency men—9,000 reporting in addition to the department's regular force of 3,000. Second, new possibilities in clearing snow from the streets have been opened up by the motor-driven plow. One hundred and two of these machines were in service last week and cut swaths along the main arteries of traffic wide enough to permit the free movement of vehicles. Third, the use of the city sewerage system for snow disposal proved a big help in cleaning up the streets quickly. Snow which under the old plan had to be hauled miles to river dumps disappeared like magic through sewer manholes.

The man in the smaller cities has little appreciation of the seriousness of the problem created in New York City by a heavy fall of snow. Even in fair weather, when vehicles can move rapidly, the volume of traffic in some sections of the city is so enormous as to be almost unmanageable. Block up New York streets with snow, and traffic movement, difficult even under the most favorable conditions, is completely paralyzed. The economic value of an efficient snow-removal system, especially at this time of the year when the shop delivery services are carrying their Christmas loads, mounts up into stupendous figures.

The snow fighting plan which proved so effective in last week's storm has been studied carefully and perfected in many of its details for the past three years. It has now emerged from the experimental stage and is in working order. Its success was proved last week.

A Blow at National Unity

DURING the campaign just closed we heard many protests against raising the issue of sectionalism. It was pointed out that the strength of these United States was dependent upon adherence to common ideals, upon a determination of the people in every section to put the nation first and to subordinate local issues.

With the general principle enunciated there was, in the country as a whole, hearty concurrence. Hardly has the echo of the protest died away, however, before there is proposed in the Congress of the United States a measure that would tend to emphasize sectionalism by preventing the maintenance of magazines with national circulations. We feel certain that those responsible for the measure—the members of the House Committee on Post Offices and Post Roads, did not appreciate this inevitable consequence of what they propose.

The measure in question forms a clause in the Post Office appropriation bill. It would put the rates for second-class mail matter (periodicals) on a zone basis. Instead of the postage being one cent per pound, it would be, should this measure prevail, one cent per pound for deliveries up to 300 miles; 2 cents for 300 to 600 miles; 3 cents for 600 to 1,000 miles; 4 cents for 1,000 to 1,400 miles; 5 cents for 1,400 to 1,800 miles, and 6 cents over 1,800 miles. According to this schedule the subscriber in California would have to pay an excess rate of 5 cents per pound on his copy of the Engineering Record, and since the copies average 20 ounces in weight the amount to be added to the subscription price would be $3.25 per year. It does not need experience in the publishing business to realize that the number of subscriptions in California would drop off very rapidly.

What is true of the Engineering Record's circulation in California would be true of that of every magazine published in the East, while, on the other hand, the circulation of California papers and magazines on the Atlantic seaboard would be seriously curtailed. Citizens of the East would know less of Western experiments in government; knowledge of labor legislation, of welfare work in the East would filter only slowly to the Pacific Coast. There would be one reader of publications, issued at a distance, where now there are twenty, one center of enlightenment instead of a score. Likewise the discussion of national aspirations, of national policies would be restricted by sections in accordance with the sectionalized distribution of periodicals—the media of intercommunication. Consequently sectional views of important national issues would be strengthened, to the detriment of that wonderful spirit of national unity which is the marvel of the traveler as he goes from coast to coast.

The sectionalization, too, would be carried through every line of trade, through every profession. The country doctor would be less likely to learn of new methods of disease treatment developed in the big centers; the engineer, the farmer, the banker in one section will go on with obsolete practices while better ones are employed elsewhere; the local merchant, whom the Federal Trade Commission is now trying so hard to educate, will, voluntarily, if you please, cut himself off, on account of the high combined subscription and postage rates, from knowledge of trade conditions elsewhere.

Moreover, the increased rates will apply not only to magazines and newspapers, but to the proceedings and publications of societies—in a word, to every periodical now accorded second-class rates. The "Proceedings" of the American Society of Civil Engineers, the "Journal" of the American Waterworks Association, the publications of scientific, agricultural, medical and similar organizations—agencies of enlightenment, instrumentalities for building the prestige of America and strengthening it commercially and industrially—would have to bear the additional burden.

The Government of the United States has in the past spent millions of dollars in educational work. What else is the main purpose of the Department of Agriculture, the Bureau of Mines, most of the divisions of the Department of Commerce, not to mention the appropriations to the agricultural experiment stations and to the land-grant colleges? Yet here is a blow aimed at what is, excepting only the schools themselves, the greatest educational force in the land.

We are certain that this curtailment of educational facilities, this menace to a force making for nationalism against sectionalism, has not been appreciated by the authors of this legislation. Nevertheless, if the people of the country do not speak, the silence may be construed as consent. Your Congressman will be home during the Christmas holidays. See him and impress on him that you as a reader of magazines and as a supporter of professional societies believe that a serious injury would be done the progress of this country by the proposed legislation.

European nations in the throes of a terrible struggle are invoking every power to keep their citizens intent upon their respective national ideals. National unity alone can save them, if they are to be saved. Moreover, a new thought as to education, as to the development of national strength in trade and in industry pervades these nations. As Frank A. Vanderlip recently said, if we are not awake the descriptions, "New Europe and Old United States," will soon be correct.

While Europe builds up, spiritually and industrially, shall we pull down?

A Distinction Between Mining and Subway Construction

AT THE TIME of the Seventh Avenue and Broadway accidents, resulting in the collapse of street decking over subway construction in New York City, an editor of the *Engineering and Mining Journal* asserted that the civil engineers connected with this work did not know their business and that a "mining expert" should be employed. Dame Rumor has it that one of the Public Service Commissioners, who is neither a civil nor a mining engineer, was so impressed with this contention that he insisted upon the employment of such an expert. At any rate, a mining engineer, H. G. Moulton, was appointed adviser to the commission.

It is not the intention of the Engineering Record to reflect on Mr. Moulton's ability or on his integrity. The one is assumed to be of high grade and the other above reproach. Nevertheless, he has publicly attacked the prevailing methods of subway construction before the American Society of Civil Engineers. Furthermore, as related to this journal by more than one contractor, Mr. Moulton has objected to any type of subway shoring that includes the use of steel falsework. This journal, therefore, cannot pass over the opportunity to refute his contentions, afforded by the publication, on page 760 of this issue, of a description of the most recent and highest development of combined steel and timber street support.

Mr. Moulton, in his discussion before the American Society of Civil Engineers of a paper presented Sept. 20 by Israel V. Werbin on the Lexington Avenue subway work, advocated the use of square set timbering for supporting the walls and roof of treacherous rock excavation. He pointed out that in mining practice small dapped timbers, giving 5 x 7 ft. panels, spaced on 5-ft. centers, had been found safer and more economical than the long needles and posts formerly used on the theory that the greater open space made cheaper excavation possible.

There is no reason to question these assertions so far as mining engineering is concerned. There is, however, this difference—fatal to Mr. Moulton's contentions—between ore mining and subway excavation: When the mining engineer has removed his ore body he is through. When the subway contractor has removed his excavation he is less than half through. A finished structure must be built and backfilled in the subway excavation. If proper clearance for erecting and concreting the structure is not provided, the additional cost will overbalance any saving effected by mining methods in taking out the rock. On section 3 of routes 4 and 36, referred to in this issue, the rock excavation will cost the city $1,175,240, at a unit figure of $5.25 per cubic yard for the bulk of the work. The total excavation for the main cut, including earth, will cost less than half the contract price of $3,741,000 for the finished section. Of the remaining work, the structural steel erected represents $498,150 and the concrete $443,500. The lowest cost given by Mr. Moulton for mining ore according to the system he outlines (and including timbering) is $4 a yard. This does not allow for any overhead, which it is safe to say is a factor included in the price of $5.25 for rock excavation on the section in question. Even granting a saving of $1.25 a yard on this entire rock cut, the cost could have been lowered by mining methods about $277,000 on Mr. Moulton's most favorable estimate. This saving would be largely offset by the increased erection cost for the structural steel alone. Judging from other structural contracts let about the same time, the difficulty of handling and erecting the steel underground, even with the favorable conditions on the contract described, increased the cost from $5 to $30 a ton above prices for similar steel erected in the open. A further increase of $20 a ton, which is a low estimate of the added cost of wriggling long steel beams and columns through a thick-set forest of mine timbering, would mean $126,000 added to this item. Not only would the direct cost increase, but the speed of construction would be far less than at present. Consequently, the overhead cost of the entire work would be increased while the city would continue to pay interest waiting for the lines to be placed in operation.

Moreover, structural steel is not the only item the cost of which would be increased by adopting mine timbering methods. The cost of formwork and of concreting would be proportionately higher. Any one who has kept costs on placing concrete where cofferdam bracing had to be removed is well aware of this fact.

Mr. Moulton's only remaining argument for mine timbering is that of increased safety over present methods. Mines are not free from serious accidents. Neither would mine-timbered subway cuts be proof against them. Subject to vibration and impact, to constant shifting and replacement not necessary in a mine but imperative where a finished structure must be built within it, such a system of timbering might well be more of a potential danger than a safety asset. Certainly it cannot be asserted offhand to be absolutely safer than the system of street support in use on the subway section mentioned. Yet, this journal is informed, Mr. Moulton has condemned this system solely on the ground that it makes use of steel falsework to provide open working space.

This entire controversy is bound to be a point of friction with the contractors and with the engineering staff of the commission. Friction is expensive. The moral is, when an outside expert must be brought in to advise on special problems, he should be an expert in those problems and not in other matters of an inherently different nature.

New Center-Cut Method Avoids Vertical Side Face in Bad Rock on New York Subway Work

31,000 Yards Removed in One Month on Section Notable for Size, Speed of Construction in Congested District, Improved Timbering Methods and Excellence of Street Decking

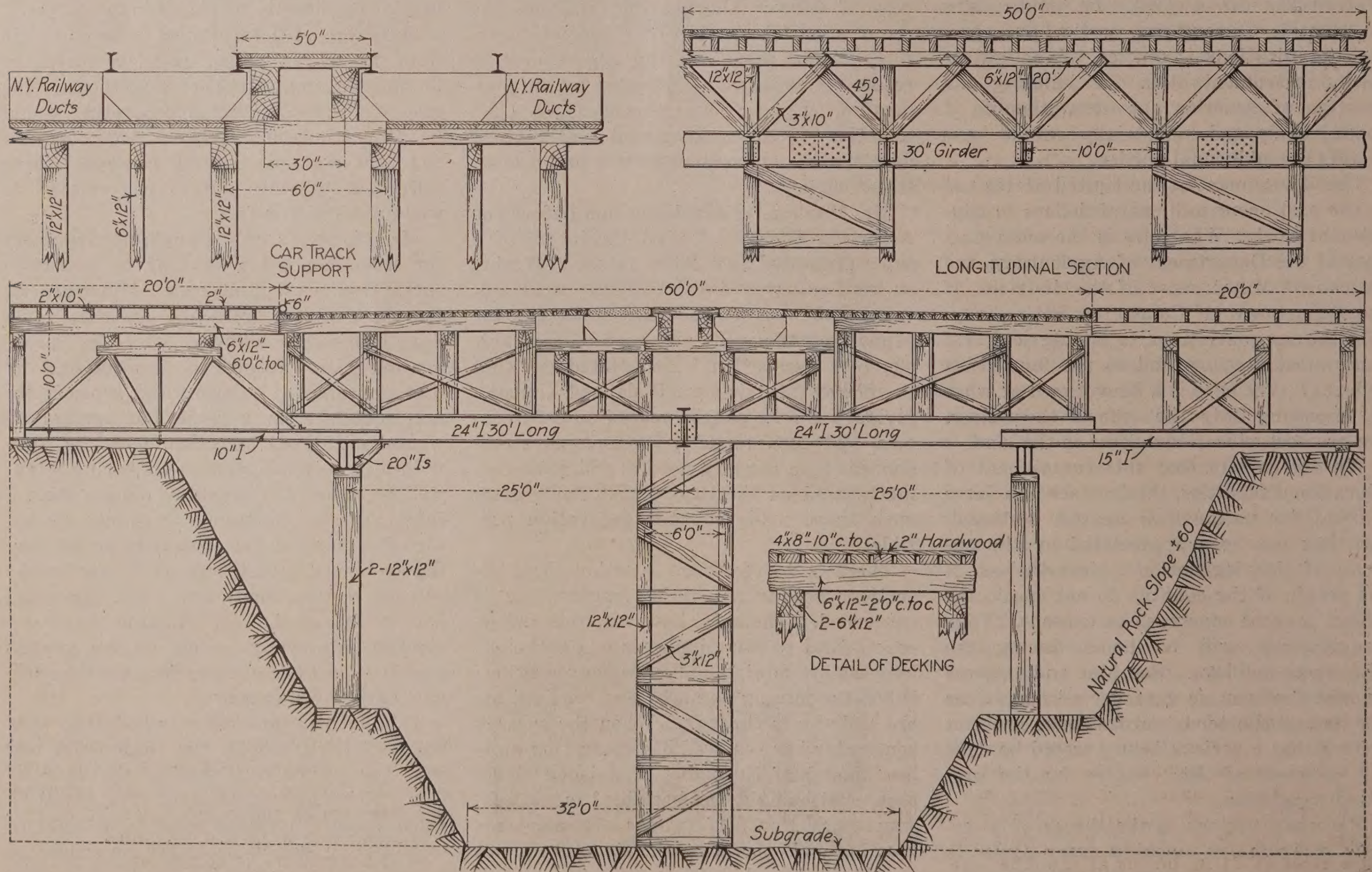
ONE of the largest rock-cut sections in the new subway system of New York City is being built beneath the most densely traveled parts of Broadway and Seventh Avenue at a rate, it is said, never before approached in such construction. New methods developed on this work have made possible the excavation and disposal of 31,000 cu. yd. of rock in one month, the rapid building of the permanent structure and the safe handling meanwhile of treacherous vertical rock faces along the building lines. A decking is being maintained on the thirteen blocks of sidewalk and roadway over this section which is evidently better than some of the permanent paving in adjoining cross-streets. Aside from the shaft plants and the disposal arrangements, which were described in the Engineering Record of Jan. 29, 1916, page 152, the most important factor in the unusual progress of the work has been a well-planned system of construction in which the decking is carried on a horizontal bolt-connected steel framework. After this part of the construction has been placed in a top cut, a center cut two tracks wide, with sloping sides, is made, in which the middle part of the permanent structure is built. The work of underpinning adjoining buildings is carried along as this cut is excavated. The roof over the outside tracks and platforms (a large portion of the section consists of an express station) is then placed, after which the remainder of the rock at the sides is broken out to a previously line-holed face. Only enough is excavated at a time on each side to set up and concrete five or six panels of side wall, although at this stage all buildings have been underpinned to subgrade and any thrust developing from a tendency of the fissured rock mass to move is carried across the cut by the finished roof.

"Keel" Construction Supports Street

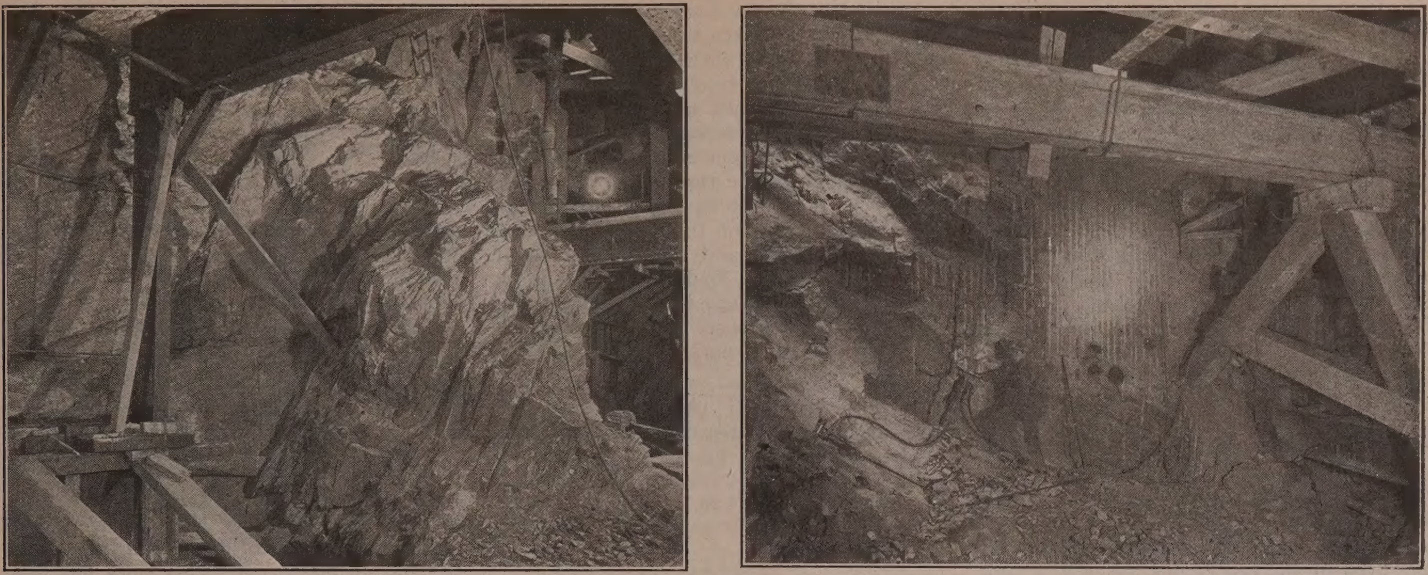
The first operation in decking the streets was accomplished by removing the paving alternately on each side, excavating to a depth of 2½ ft. from the surface and placing the timber deck down to the bottom of the 12-in. timbers which run parallel to the street under the roadway and under the car tracks. This decking is unusual in having a 2-in. wearing surface of hardwood plank laid at right angles to the street on 4 x 8-in. timbers parallel to the street and laid with 2-in. spaces between them. These rest on 6 x 12-in. timbers, which in turn are supported by 6 x 12-in. longitudinal timbers lapped by for half the length and bolted together to form a continuous 12 x 12. The strength of this construction, which is designed to carry over a 10-ft. span the 10-ton load on the two rear wheels of the largest-sized trucks, together with the rigidity of the steel underframe which supports the decking, is thought to be responsible for the fact that the street surface on this section has been free from settlement, the car tracks have remained in good alignment and the surface of the roadway remains smooth and even after a year or more of very heavy service.

After the decking was in place, a cut 10 ft. deep was made below it for the full width of the street, the material being taken out at the shafts. On the floor of this cut was laid a "keel" of 30-in. girder beams, placed end to end and fastened together with bolted splices equal in shear to the strength of the beams. This line of beams is continuous. Into the sides of this "keel" are framed with bolted connections 24-in. I-beams 30 ft. long, at 10-ft. intervals. The outside ends of these beams are supported by a triple line of 24-in. I-beams approximately below the curb line on either side of the street. The lower flange of each of the transverse beams is bolted with four bolts to the upper flange of each of the longitudinal beams at the side of the street. The 12-in. longitudinal timbers under the street and car tracks are posted down to this framework with 12 x 12-in. timbers. Bolted diagonal scabs of 3-in. plank from the lower ends of the posts to the sides of the stringers above reduce the chances of their being displaced and add stiffness to the construction.

The sidewalks are supported on trusses on 10-ft. centers which lap by the transverse



RIGID SUPPORT FOR STREET DECK ARRANGED FOR RAPID PROGRESS—CUTTING VERTICAL SIDE FACE AVOIDED TILL PERMANENT STEEL IS PLACED



Photographs by Charles Spero

REMAINING SIDE BENCH BETWEEN STEEL CONSTRUCTION APPROACHING FROM BOTH DIRECTIONS, AND ROCK BROKEN TO LINE-HOLED FACE

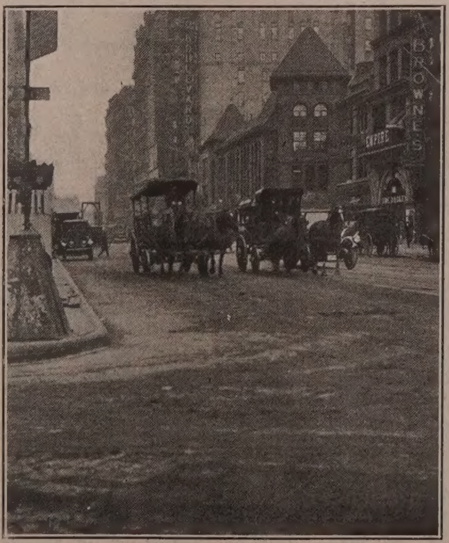
24-in. beams and rest on the triple line of 24-in. beams. The bottom of each of these trusses consists of a 10-in. I-beam, and the outside end of each truss rests on rock outside the lines of excavation. In this way the necessity for needlebeams, which would have to be shifted as the main excavation progressed, was eliminated and a rigid construction provided which could support the street loads with timber towers and heavy posts over spans up to 30 ft. As the top of the permanent structure is below the level of these beams, free working space for all the construction operations is provided by this system, and at the same time it is considered so strong as to be in little danger from rock fragments hurled by a blast.

DANGEROUS FORMATION REQUIRES CENTER CUT

Nearly all the material removed in the first cut was rock, the paving in most places resting directly on the rock. The schist which is found in this section of Manhattan dips at a steep angle to the west, and besides having a general tendency to slide along the bedding planes, which is likely to cause material to slide in on the east side of the cut, the joint planes in the formation are practically parallel to the line of the subway, and consequently do not show in the walls of the cut. On this account there is constant danger of masses of apparently sound rock falling in from the west side of the cut. For these reasons it was thought best not to excavate the full width of the cut, which would have left vertical faces on each side that would have been sources of danger no matter how closely the heading could be followed by the steelwork of the finished structure. A center cut down to grade, with sides sloped back to the neat lines at the top and with sufficient width on the bottom to permit building the center portion of the permanent structure, containing the two express tracks, is therefore carried in advance of the rest of the work. Much of the section is so deep, however, that before starting the center cut a second full-width cut of 10 ft. depth is made. The center steel "keel" of the street support is carried on towers to the floor of this cut, while the triple rows of 24-in. beams at the sides are carried on 12 x 24-in. or 16 x 16-in. timber posts resting at safe points on the banks of the cut. As these headings progressed the footings of the buildings on both sides of Broadway were carried down to the subgrade by excavating pits beneath them and filling these pits with concrete. The muck from these pits was disposed of by sliding it down chutes, built on the sloping sides of the center cut, which discharged directly into the wheeled skips used for removing the muck from the main heading.

Where light buildings were not underpinned, concrete walls at the sides of the cut were built to retain the rock beneath them during construction. The tops of these walls, at the level of the steel street support, were secured to each transverse beam by stirrups bolted to the beam and bearing on the face of the wall at the top, so that the thrust was transferred across the cut by the steel falsework.

As fast as the center cut is made, the steel for the two center tracks is erected and the structure concreted. The long "keel" is posted down to the permanent steel as it is set, the posts resting on concrete blocks on the roof girders so that no patching remains to be done when the posts are removed for backfilling. As fast as this part of the structure is completed the usual rubble masonry piers are built on it from stone taken from the cut permanently to support the street-car tracks.



DECKING THAT STAYS IN PLACE

SIDE EXCAVATION HANDLED CAREFULLY

When this has been done, the upper half of the sloping bank of rock remaining in place at each side of the cut is broken back to the neat lines to permit placing the remaining roof steel at the sides. Rock enough to allow the placing of from two to five roof beams at a time, depending on conditions, is taken out. Before any of this mass is drilled for blasting, vertical line holes are drilled along the neat line on each side of the cut downward from the top of the bank. These holes are from 6 in. to 2 ft. apart, depending on the condition of the rock, and are drilled with jack hammers using steels up to 14 ft. long. By this means overbreak, which would be very dangerous in this formation, is entirely avoided. These top excavations at the sides of the center cut are carried along as two continuous headings, the steel being set and concreted as each section is excavated. The rock taken out is dropped into the wheeled skips down the wood chutes used to remove the material from the underpinning pits. The outer ends of the side roof beams are supported by light needles until the side walls can be placed. Over the space where this construction is in progress the ends of the transverse street-support beams are carried by runner beams, the forward ends of which are supported from the rock shelf and the rear ends posted down to the floor of the cut behind. Second-hand plate girders 60 ft. long and 4 ft. deep are used for these runners.

ROOF STEEL SUPPORTS ROCK WHILE MAKING FINAL SIDE CUT

From the bench at each side, formed by cutting out the rock to place the roof, line holes are extended down to the bottom of the cut, after which the remaining wedge-shaped mass of rock is broken out on each side to the final lines of the excavation. This is done in sections of about the same length as those taken out in placing the roof. The column footings for the side walls are then poured and the side columns set, after which the runners can be moved before the side walls are concreted.

As the structure is completed, short sections of the decking and the street support on alternate sides are taken up and backfilled in the usual manner.

WHEELED SKIPS AID IN HANDLING MUCK

The wheeled skips, which were described in the article referred to, are said to have greatly increased the economy of these operations. The four wheels and journals are set into the body of the skip at the bottom, and the bottom plate is only a few inches above the rail. This construction made it possible to build 1½-yd. skips, which stand less than waist high from the floor of the cut, and which are consequently very economical to load. The skips are used not only to convey muck, but to take the place of the platform cars usually required to transport the steel. These skips are operated on a double-track line, with turnouts at shafts located at Thirty-ninth, Forty-first, Forty-third, Forty-sixth and Forty-ninth streets, and laid first on the floor of the initial wide cut and subsequently on the floor of the center cut.

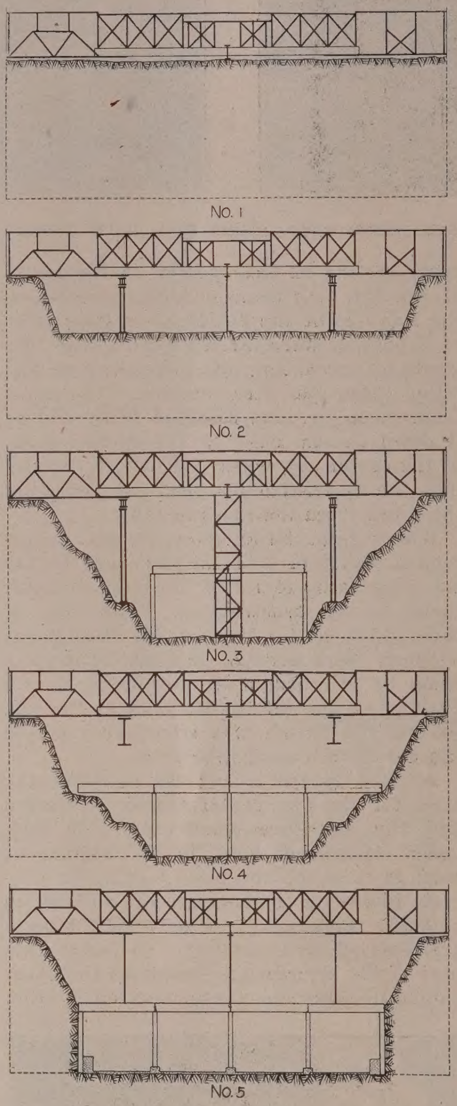
The entire system for supporting the street and attacking the rock excavation made it possible to open up large bodies of rock at the outset and take out more than half of the total excavation required during the first year of the contract. While the rock remaining at the sides cannot be taken out at such a rapid rate, the work is just as economical, as it permits the continuous employment of a full crew. Moreover, the center cut clears the way for the erection of a large portion of the permanent structure, so that the last of the excavation does not have to be finished so far ahead of the remaining work on the contract, in point of time, as is the case where a full-sized cut section is taken out before any of the permanent structure is erected.

DUPLICATE AIR LINES SUPPLY DRILLS

The main compressor plant, containing seven electrically driven, direct-connected two-stage machines, with a combined capacity of 7000 cu. ft. per minute, is located in the triangle between Broadway, Forty-third Street and Seventh Avenue. From this plant 6-in. air mains are run on each side of the cut up Seventh Avenue and down Broadway. In these lines are made up T's at every second joint, to which lines are connected as needed leading to manifolds, from which smaller lines supply the air hoists and drills. Each of the main air lines is fitted with a U-bend expansion joint at every cross-street, and the two lines on each side of the cut are cross-connected every block. In this way any damaged section of either of the air mains can be cut out by closing the valves at each end of it, and the tools fed from this line can be supplied with air through the cross-connections from the other main. The maximum load on this compressor plant so far has been seventy-three jack hammers, 6000 gal. capacity in air pumps, twelve 6 x 8-in. single and double drum air hoists, and several riveting hammers and wood-boring tools.

The structural steel is handled by the twelve air hoists mentioned and by fourteen 10-hp. single-drum electric hoists. In addition to these hoists, several electric riveting hammers and wood-boring tools are used below ground. It has not been necessary to use any hoists to pull the muck skips. The hauls are short, it has been possible to keep the tracks practically level and the skips roll easily. Under these conditions it has been as cheap to push them by hand.

Practically all the hauling in connection with the contract, except the delivery of the steel, has been done with motor trucks. Indeed, it is not considered possible that horse-drawn vehicles could have removed rock and delivered concrete in the congested district in which the contract is located at the rate required by the rapid progress of the work. The concrete is mixed at a water-front plant located on the contractor's dock at Fiftieth Street and the Hudson River. It is hauled in 4-yd. loads by back-dumping motor trucks and deposited on the decking over the point of concreting. The truck bodies have square corners, and the dumping mechanism does not tilt them high enough to make the concrete slide out quickly. Under these conditions it has been found best to mix the concrete rather dry, loosen it when the truck is dumped with an air jet of ¾-in. pipe and remix it with more water before shoveling it down the vertical chutes to the forms. Three of these trucks are employed and each can deliver without difficulty 52 yd. of concrete in an eight-hour day over the 1½-mile round trip.



PROGRESSIVE CONSTRUCTION STEPS

1—First cut to set steel deck support; 2—Second cut to reduce side slope of center cut in deep part of section; 3—Center cut made, center steel set; 4—Side roof beams set; 5—Structure finished

The trailer trucks which dispose of the excavation carry 9 yd. at a load, and the fleet of them has often disposed of 1100 cu. yd. of loose rock in twenty-four hours. These trucks and the five shaft plants were expected to reach a maximum capacity of only 1000 yd. of loose material a day. At three of the shafts the hoisting is done by electric cranes, while at Forty-sixth Street a steam crane is used and at Forty-ninth Street an electric telpher.

CROSSING UNDER OLD SUBWAY PARTLY BUILT

The contract is practically divided into two separate sections by the existing subway at Times Square. At the time the present subway was built a future extension down Broadway was provided for by constructing a double-track section parallel to Broadway under the Times Square station. This section, which has remained sealed up since the old subway was built, and which is now to be incorporated in the new structure, is directly east of the foot passage under the station at this point. The roof of this old construction will be retained, but the cut will have to be widened and deepened to accommodate four tracks and the station platforms. This work has been left till the last partly because it could not be reached till a block length of excavation at each side from the shafts at Forty-first and Forty-third streets had been completed and partly because of the drainage conditions in the north section of the work. Also, the work will involve the temporary reconstruction of portions of the Times Square station, and it was desirable to have the time interval between the disturbing of present conditions and the completion of the new work as short as possible. The only work done so far at this point, therefore, has been to drive a 6 x 6-ft. drift from the heading on each side into the old tunnel section under the station, which has helped the drainage of the north section of the work.

POOR DRAINAGE DELAYS PROGRESS

While the sewers below Forty-second Street are capable of carrying the maximum runoff from heavy rains, those above Forty-second Street are not. A new intercepting sewer, required to relieve this situation, is now under construction in connection with the subway work. In the meantime, however, the cut north of Forty-second Street has been flooded on numerous occasions, the work has been seriously delayed and traffic has been interfered with at times on the present subway. Notwithstanding these difficulties, the top cut has been made for the entire section and the center cut has been completed except for one block at the north end. Also, a good deal of the permanent structure has been built in these blocks. However, work is not so far advanced as on the section south of Forty-second Street, where backfilling has begun at the lower end, and the conditions outlined may make it impossible to complete the upper portion of the work before May 8 next, when the time limit expires. This is not so serious as if the lower section had been affected in view of the fact that the operation of the line above Forty-second Street could hardly be expected to develop heavy traffic until the completion of the Sixtieth Street tunnel under the East River. When this section was first contracted for it was expected that the Broadway line would operate over the Queensboro Bridge, in which case trains from that borough could probably have been run across Fifty-ninth Street and down Broadway to Brooklyn before the end of next year. With the change adopted from the bridge crossing to a tunnel this will now be impossible, and therefore the necessity for completing the lower section, so that operation from Times Square to Brooklyn can be begun, is more urgent than that for the completion of the upper portion of the work.

The work described, section 3 of routes 4 and 36, Broadway-Fourth Avenue Subway, is being constructed by the Holbrook, Cabot & Rollins Corporation, under the direction of George Hallett Clark, for the Public Service Commission, of which Robert Ridgway is engineer of subway construction and Jesse O. Shipman, engineer of the division including the work.

Surge-Tank Problems Solved by New Methods

Simplified Analysis of Oscillations of Water Surface in Standpipe Makes Use of Calculus Unnecessary

By A. G. HILLBERG
Hydraulic Engineer, New York City

SEVERAL WRITERS have dealt with fluctuations in surge tanks for different changes in load on a power station. The majority of the methods developed, however, end with equations giving the top of the first wave and the time needed for it to reach its crest. Most of them have also assumed that the frictional resistance in the long conduit is in a direct proportion to the velocity, or $h_f = nv$.

By using the Chezy formula $v = c\sqrt{RS}$, where S is head lost (h_f) divided by length of conduit (L), it can be proved that

$$h_f = \frac{L}{c^2R}v^2 = nv^2 \qquad (1)$$

It will be found, on examination of the literature on this subject, that all authors have used integral calculus in dealing with the problem. As some engineers have difficulty in using calculus, it might be of interest to know that surge-tank problems can be solved without involving higher mathematics. Furthermore, it is not enough to calculate only the crest of the first wave. In order to know whether the tank is large enough for its purpose several waves should be taken into consideration, and the possibility of further load changes before the wave action has died out should be given attention.

To simplify the problem as much as possible it will be assumed that the elasticity of the penstocks has no influence on the surge. To neglect this influence will not introduce any material error, as greater possibility of error prevails in the assumption of the friction coefficients contingent to the flow in the pressure conduit.

If no friction prevailed, a sudden load increase demanding more water would draw down the level in the tank, thus decreasing the head on the turbines. The governor would then open the gates, permitting more water to flow to the runner. This would draw the water level down still further. When finally the velocity in the conduit had been accelerated sufficiently to stop the drawdown of the water level in the tank, the water would rise in it until the original level had been reached. Thus the wave action would be continued with constant wave length and variations in level.

Friction, however, enters into the problem. It will tend to hold back the water column in the conduit by delaying the acceleration of its velocity, thus increasing the depression of the water level. Later, when the water rises, the frictional force will again retard the velocity change, thus reducing the crest of the wave. Consequently, if no additional change in load occurs, the water level will fluctuate with smaller and smaller oscillations, until finally the new level has been attained.

When the water rises in the tank a certain amount of work is required to lift it. Consequently, the following equation can be established:

$$\tfrac{1}{2}mv_1^2 + W = \tfrac{1}{2}mv_2^2 + F \qquad (2)$$

where m is the mass; v_1 and v_2, the respective velocities before and after a certain interval of time; $\frac{1}{2}mv_1^2$ and $\frac{1}{2}mv_2^2$, the respective kinetic energies; W, the work done in lifting the water, and F, the work done by the friction.

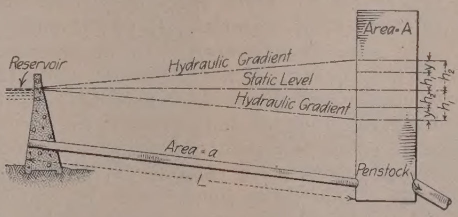
If now, at the beginning of the interval considered, the water level in the tank is h_1 feet below the static level, and afterward it will be changed to h_2 (see drawing), the work done in lifting it will be

$$W = \gamma A(h_1 - h_2)\left(h_1 - \frac{h_1 - h_2}{2}\right)$$

or

$$W = \gamma A(h_1^2 - h_2^2)/2 \text{ ft.-lb.} \qquad (3)$$

Neglecting the velocity head, which is small as compared with the friction head, the work done by the friction is



$$F = \gamma Q h_{fm} \text{ ft.-lb.}$$

where Q is the total discharge during the interval of time and

$$h_{fm} = nv^2_m$$

If the discharge in second-feet is q, and an interval of time t is considered, or $Q = qt$, the work done by the friction is

$$F = \gamma qth_{fm},$$

where h_{fm} is the mean friction loss during the time, t. However, $q = av_m$, where a is the area of the conduit and v_m the mean velocity.

For all practical purposes it is close enough to put

$$v_m = (v_1 + v_2)/2$$

when considering that t is a very short interval of time. Furthermore, it is accurate enough to put

$$h_{fm} = (h_{f_1} + h_{f_2})/2$$

But it has already been shown that $h_f = nv^2$, so that

$$h_{fm} = \frac{nv_1^2 + nv_2^2}{2} = \frac{n}{2}(v_1^2 + v_2^2)$$

Consequently the equation for the work done by friction can be rewritten

$$F = \gamma a\frac{v_1 + v_2}{2}\ t\ \frac{n}{2}(v_1^2 + v_2^2) \qquad (4)$$

Introducing the expressions for W and F, equations 3 and 4 respectively, in equation 2 it becomes

$$\frac{m}{2}v_1^2 + \gamma A\frac{h_1^2 - h_2^2}{2} = \frac{m}{2}v_2^2 + \gamma a\frac{v_1 + v_2}{2}\ t\ \frac{n}{2}(v_1^2 + v_2^2)$$

which can be rewritten to read

$$\frac{m}{2}(v_1^2 - v_2^2) + \gamma A\frac{h_1^2 - h_2^2}{2} - \gamma a\frac{v_1 + v_2}{2}\ t\ \frac{n}{2}(v_1^2 + v_2^2) = 0 \qquad (5)$$

From this equation it is obvious that as long as $h_1 > h_2$ (that is, when the water level is below the static level) the work done in the tank is positive. After that, when $h_1 < h_2$, this work is negative, thus tending to retard the surge. Therefore by taking h_1 and h_2 from the static level no change in sign need be made after the wave has passed this level.

After the time interval t the water has risen y feet in the tank, so that

$$Ay = atv_m = at\frac{v_1 + v_2}{2}$$

from which

$$y = \frac{a}{A}\ t\ \frac{v_1 + v_2}{2} \text{ feet.} \qquad (6)$$

From the figure it is obvious that for water levels below the static level $y = h_1 - h_2$ feet, while for levels above the static $y = h_2 - h_1$ feet. Therefore $h_2 = h_1 \pm y$ feet. Furthermore, $m = \gamma aL/g$. If these expressions are introduced in equation 5, and it is solved for v_2, the following expression is obtained:

$$v_2 = -\left(\frac{L}{ngt} + \frac{at}{4An}\right) + \sqrt{\left(\frac{L}{ngt} + \frac{at}{4An}\right)^2 \pm \frac{2h_1}{n} + \left(\frac{2L}{ngt} - \frac{at}{2An}\right)v_1 - v_1^2}$$

This equation, however, can be written in a simpler form by putting

$$U = \left[\frac{L}{ngt} + \frac{at}{4An}\right]$$

and

$$S = \left[\frac{2L}{ngt} - \frac{at}{4An}\right]$$

so that

$$v_2 = -U + \sqrt{U^2 \pm 2h_1/n + v_1(S - v_1)} \qquad (7)$$

As mentioned before, the term $+2h_1/n$ should be used for water levels below the static and $-2h_1/n$ for levels above.

The time t should be a period as short as possible, so as to reduce the influence of the approximations. As in many cases one second will give too many computations, intervals of 5 or even 10 seconds can be used without any serious error being introduced.

When the wave reaches its crest $v_2 = 0$ the downward movement will begin. To calculate accurately the time required for the wave to reach its maximum, the last few computations should be made with intervals not exceeding 1 or 2 seconds.

It is, however, necessary to assume the size of the area A or the cross-sectional area of the tank, the area a, or the size of the conduit, having already been determined from other considerations.

If as before h_1 is the distance of the initial level below the static level in the tank and y_{max} is the distance above the static level to the top of the surge, for a sudden full shutdown, making $v_m = v_1/2$, the following formula can be made use of:

$$A = \frac{av_1^2}{g} \times \frac{L}{(h_1 + y_{max})y_{max}}$$

This expression gives results that are from 1 to 3 per cent too large, but close enough for preliminary calculations. It was developed by A. Strickler and published in the *Schweizerische Bauzeitung*, Vol. 64, 1914.

By assuming a series of values of y_{max} the corresponding areas A can be determined and the most suitable selected.

In order to assist in choosing the most suitable interval of time the formulas of R. D. Johnson or L. F. Harza for the maximum surge and the time required for it to reach its crest should be made use of. Mr. Johnson's formulas read:

$$y_{max} = \sqrt{\frac{aLv_1^2}{Ag} + h_f^2} \text{ feet}$$

and

$$t = \frac{\pi}{2}\sqrt{\frac{AL}{ga} + \frac{n^2v_1^2A^2}{a^2}} \text{ seconds.}$$

Mr. Harza's formulas are

$$y_{max} = \sqrt{\frac{a}{A}v_1^2\left(\frac{L}{g} - \frac{ntv_1}{3}\right)} \text{ feet}$$

where

$$t = \pi\sqrt{\frac{AL}{ag}} \text{ seconds.}$$

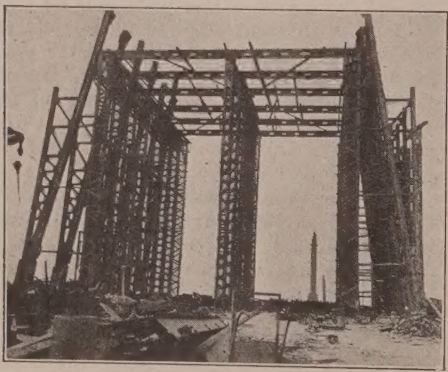
In these four latter equations y_{max} is measured from the initial level to the top of the surge. All other symbols are as before.

For calculating the water hammer in the penstocks, which can be considered as a separate problem from the surges in the tank, the formulas given by Vincent P. Marran in his article "Practical Procedure in Designing Penstocks," published in the Engineering Record of March 20, 1915, page 355, should be used.

Tower of Jewels Salvage Readily Marketed

Exposition Structure Dismantled Without Accident and with Negligible Damage to Material—Wrecking Cost $25,000

DURING the last week in November there was completed the wrecking of the Tower of Jewels, which was the last of the Panama-Pacific Exposition structures to be dismantled. The tower was sold by the exposition company for $9,000 to Weissbaum & Company just as it stood after the close of the exposition. It contained 1800 tons of structural steel and about 2,000,000 ft. b.m. of lumber, but its 435 ft. of height considerably complicated the problem of economical dismantling in a way that would not damage the salvable material. The safety of workmen was also considered an important item. During erection of the structure there were three fatal and a number of minor accidents, and it was believed that the work of dismantling would be more dangerous.



90-FOOT COLUMN STUBS, LEANING AGAINST FALSEWORK, WERE FELLED SINGLY

Wrecking operations were started April 2, 1916, and the last standing column was taken down Nov. 23. During this time, in which the crew on the job ranged from 12 to 20 men, neither serious nor fatal accidents were reported. The complete cost of dismantling is stated to have been $25,000, including insurance and all overhead.

The wreckers began at the top, lowering most of the material from derrick booms. The steel frame was unbelted or cut with acetylene torch where necessary. The columns which supported the arch 125 ft. high in the base of the structure were stripped and their upper parts removed so that the height of the columns which it was finally necessary to "fall" was only 90 ft.

The work was done in such a way that less than 2 per cent of the structural steel shapes were damaged in handling, and thus the major portion of the steel commanded a high price. The resale of the structural-steel members netted $65,000, in addition to which the major portion of the lumber in the structure was disposed of at from $10 to $12 per 1000 ft. b.m. Most of the steel was sold to a local rolling mill which manufactures structural shapes.

The work was under the supervision of the Safety Department of the State Industrial Accident Commission, of which John R. Brownell is superintendent of safety. Personal attention to this job was given by J. J. Rosenthal, safety engineer. Inspections of the work were made three or four times a week, and the cables, derrick loading and derrick supports were constantly examined and checked up, minor changes being made in accordance with the recommendation of the state officials.

Letters on Hydrated Lime Which Won Prizes

Cite Advantages of Material When Used in the Construction of Bridges and of a Water-Filtration Plant

IN SEPTEMBER the Hydrated Lime Bureau in order to accumulate experiences regarding the use of hydrated lime in concrete offered a series of prizes for short letters setting forth facts developed with the use of the material. It was stipulated that actual experiences must be recorded.

The contest closed Dec. 6 and the judges awarded the first prize ($100) to H. T. Whitney, of Indianapolis; the second prize ($50) to Valentine Godard, of Miami, and the third prize ($25) to F. W. Combs, of St. Louis. The judges were Warren E. Emley, associate chemist, Bureau of Standards; E. J. Mehren, editor of the Engineering Record, and Norman G. Hough, manager of the Hydrated Lime Bureau.

Mr. Whitney described the use of hydrated lime on bridges on the Indianapolis & Frankfort Railroad. Mr. Godard explained how difficulties with a none too satisfactory sand and coraline rock were overcome, while Mr. Combs set forth the extensive use of the material in the St. Louis filtration plant.

The winning letters follow:

By H. T. WHITNEY

Engineer in Charge, Indianapolis & Frankfort Railroad, Indianapolis, Ind.

Hydrated lime is being used by the Pennsylvania Lines in the construction of the reinforced concrete bridges on their new line extending from Ben Davis to Frankfort, Ind.

These bridges include box culverts, spans 10 to 20 ft.; flat-top subways, two sidewalk spans of 12 ft., and street span of 32 ft.; arch spans, 30 to 50 ft.; one arch bridge of three spans, 65 ft. each; one arch bridge of two spans, 55 ft. each—a total of 42 bridges of various types.

With the exception of the small culverts most of the bridges contain from 1000 to 1600 cu. yd. of concrete. The concrete for all the structures of any size is being handled by means of a tower. About ten of these are located at public highways, where a good supply of water could not be obtained except at a considerable expense. The use of hydrated lime enables us to cut down the water and still have concrete flow freely in the spouts.

Several of the flat-top subways are complicated skew spans with numerous corners. The lime has proved very successful in these structures, as it prevented honeycombing and gave a smooth face in parts of the structures that we could not reach to spade. The cost of spading is reduced 50 per cent by the use of lime.

OTHER BENEFITS

The lime makes the concrete more dense and more easily handled after it is deposited in the forms. It is frequently necessary to move a batch to some other part of the form when it has been deposited in the wrong place by the chute. The labor cost for this kind of work has been reduced about 40 per cent by the addition of lime.

On bridges where the reinforcing is closely spaced the lime is of great assistance because it enables us not only to place the concrete easily, but it also prevents the separation of the aggregate when the mixture is being forced between and under the bars with wooden paddles.

Because of the reduction of water in the mixture there is very little rough material deposited on the face, such as will occur when the mixture is very wet and the water seeps through the forms. This feature, together with the material reduction in honeycombing, has reduced the cost of finishing the face after the forms are taken off.

I have no hesitancy in recommending the use of hydrated lime in reinforced concrete. At the present time we are conducting experiments using it in heavy plain concrete, but these experiments are not far enough along to enable me to give you any information.

By VALENTINE GODARD

Resident Engineer for Harrington, Howard & Ash, Miami, Fla.

The city of Miami, Fla., has under construction two similar double-leaf bascule bridges over the Miami River. The lengths are about 300 ft. and the clear openings are 60 and 75 ft. The approaches are reinforced concrete, having arches in one bridge and girders in the other. In the two bridges the total yardage is about 4800, being mostly a 1:2:4 mix. Harrington, Howard & Ash, of Kansas City, Mo., are the consulting engineers and M. F. Comer, of Miami, is the contractor.

The best local sand is not all that could be desired, being too fine and poorly graded as to size, while the coraline limestone used is very irregular in shape, with many cavities to be filled and projections to prevent smooth flowing. If enough water is added to make the concrete flow, the mixture is too wet to give good strength and there is trouble from the rock occasionally staying in the chutes while the mortar runs out. If the mix is dry enough to give good strength the concrete will not flow and it requires an excessive amount of working in the forms to cover the reinforcing and to give a good surface. At its best the concrete is inclined to be porous and absorb water. The climate is warm with a damp salt air, so that a dense waterproof concrete is required to prevent rusting of the reinforcing steel.

After considering the various waterproofing compounds on the market it was decided to try the use of hydrated lime to overcome the difficulties. Forty pounds of lime was used to each cubic yard of concrete, a very convenient proportion, as half a sack of lime was added to each three-sack batch of concrete. The lime seemed to lubricate the mixture so that with the addition of but a moderate amount of water it would easily flow down the chutes. There was no more trouble from the mortar and the stone separating or from the mixture being too stiff to flow. When in the forms it required little working to thoroughly cover the steel and to give a good surface. The particles of sand appeared to flow over each other easily, so that the resulting concrete was not nearly so porous and the steel was well protected from the corroding influence of the tropical salt air.

The use of hydrated lime has been an unqualified success. It has given smoother flowing concrete, overcome the unmixing of the materials, reduced the amount of working required in the forms, given a better surface, a stronger concrete and protected the reinforcing steel. I am satisfied that it is worth many times its cost. Klyce & Kackley of Miami, consulting engineers on the new $600,000 causeway across Biscayne Bay, observing the beneficial results of its use on the Miami bridges, have specified the use of hydrated lime in the 4000 ft. of reinforced concrete viaduct portion of the causeway.

By F. W. COMBS

Of the McCormack-Combs Construction Company, St. Louis

We submit herein some data and information regarding our experience in the use of hydrated lime in concrete work. Having used this material often in our work, we pick one job, the filter plant at Chain of Rocks for the city of St. Louis, designed by the engineers of the Water Commissioner's Office, Gurdon G. Black, engineer in chief, as the best example in our experience of its effectiveness in waterproofing and in other respects.

The building is 750 ft. long by 134 ft. wide, all reinforced concrete, containing 40 concrete filter boxes, each having a filtering area of 1400 sq. ft. with a capacity of 160,000,000 gal. of filtered water all told per day, built within a basin 800x400 ft., the outer wall of filter building holding a 25-ft. head of water throughout its length.

In the outer wall, and throughout the plant, we used 25 to 40 lb. of hydrated lime to one barrel of cement in a concrete mixture of one part cement to two parts sand to four parts gravel, the wall being 750 ft. by 25 ft. by 1 ft. 10 in. thick and secured a density of concrete practically effective against leaks. The walls and bottom of filter boxes were treated in the same manner, as well as the bottom and walls throughout the entire length, 750 ft., of the influent and effluent conduit, which has dimensions approximately 11x10 ft. Besides giving an acceptable waterproof job, which under the specifications was put up to the contractor to produce, the above mixture produced a fat concrete requiring little working to eliminate porosity, reduced expansion and shrinkage cracks, gave a good surface and greatly facilitated spouting.

We further call attention to two circular tanks 50 ft. in diameter each and holding 175,000 gal. of water each, which were and still are thoroughly tight.

The entire building was poured from one central plant and concrete was easily conveyed through chutes to a distance of 400 ft. and more in a gradual fall of about 4 in 20.

We have used various integral waterproofing compounds, but have found none equal to hydrated lime, properly mixed, for all around effectiveness.

In this work we installed 20,000 cu. yd. of concrete and often used lime where not needed for waterproofing to get a fatty concrete that would not choke chutes in long distance pouring.

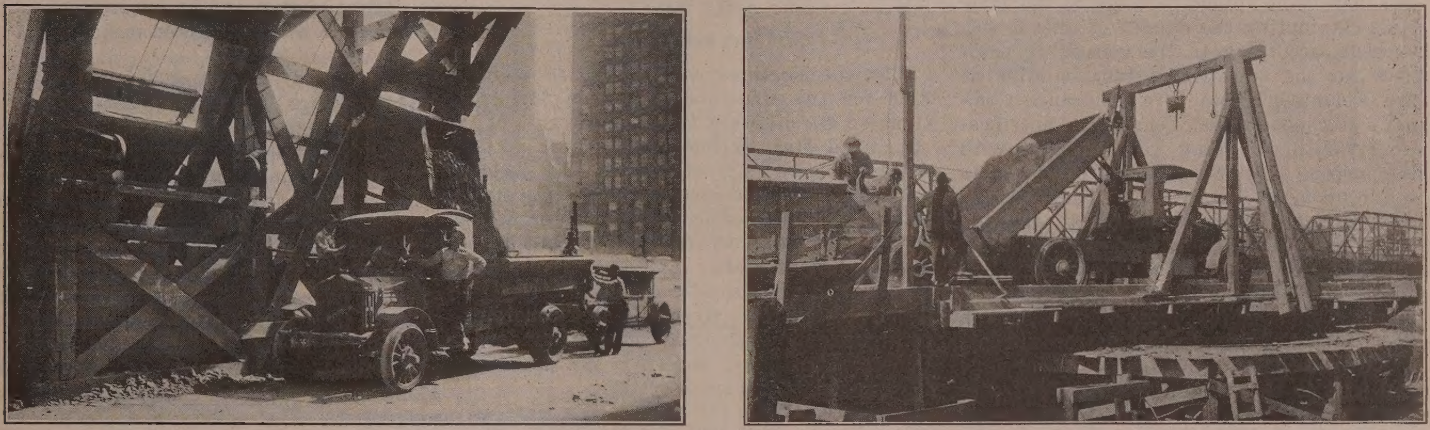
Automobile Maintenance Cost Lowered

The average cost of maintenance and operation of the thirteen automobiles of the operating department of San Diego, Cal., was brought down during the month of October to 3.4 cents per mile, the total mileage being 14,250. These figures are from the monthly report of F. M. Lockwood, manager.

Turntable Dump Saves Time of Motor Trucks

Carrying Dirt from Building Excavation, Trucks Pulled Trailers in Day, While Street Congestion Reduced Speed

THE EFFICIENT operation of a truck fleet, which included the use of gravity loading and the employment of a turntable dump, made possible the disposal of 75,000 cu. yd. of earth in 60 days. James L. Stuart, contractor for this excavation, which was made for the recently opened William Penn Hotel, in Pittsburgh, was able, with the aid of this plan, to complete the excavation 15 days inside of the time named in his bid, and in 30 days less time than the estimate of his nearest competitor. The work is thought to have proved conclusively the value of large units where the speed of travel is restricted. At night, when the three Pierce-Arrow trucks employed could operate without restriction, they were able alone to handle the output of the excavating equipment. In the daytime, however, when their speed was reduced by traffic congestion, it was necessary for each to haul a 3-yd. trailer in order to keep pace with the steam shovels.



Photographs courtesy of the Commercial Vehicle

TRUCKS AND TRAILERS HAUL 75,000 YARDS IN 60 DAYS WITH HELP OF QUICK LOADING AND TURNTABLE DUMP

INDUSTRIAL RAILWAY DELIVERED MATERIAL TO STREET

It was necessary to work 20 hours a day in order to complete the excavation within the required time. A revolving steam shovel inside the lot took out the material, loading it into industrial cars which dumped into large elevator skips, that in turn were hoisted up an incline and dumped into the trucks. The average time required to load a truck was half a minute, and the average round-trip time for the three trucks for the 60 days was 15 minutes. The distance covered within this time was 1.15 miles. During the day a longer time was required for a round trip, but at night the trucks alone operated at a much faster rate, one record of seven minutes having been made. The haul loaded was downhill to a dock at the river front.

TURNTABLE DUMP SAVED BACKING

The specially built, rubber-tired trailers used were bottom-dump, and the trucks were equipped with a hydraulic dumping device, so that even less time was required to discharge than to load. The end of the trestle at the dumping dock consisted of a turntable long enough to hold both the truck and the trailer. When the units had run on the turntable and dumped, it turned them around so that no time was lost in backing and turning the trucks.

Including stops, the trucks averaged 13 miles per hour at night when the streets were clear. In the daytime, however, no more than 8 miles per hour could be made. Each truck averaged 80 trips, or 92 miles per 20-hour day. Delays from mechanical trouble were avoided by having a night inspector, who went over each truck and kept everything in adjustment during the four hours' rest between the night and morning shifts.

Bid on Concrete Building $67,000 Less Than Steel

Columns of Chattanooga Structure Built of Rich Concrete and Carried to Rock Foundation by Piers Poured in Open Wells

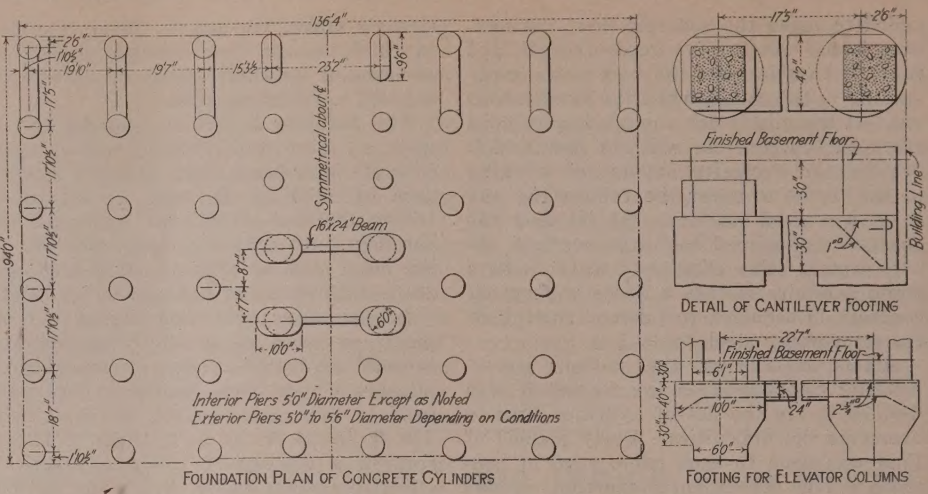
Sinking unbraced open wells through clay soil for varying depths up to 30 ft. to a solid-rock foundation and lining them with concrete was found to be more economical than using spread footings, at the same time eliminating the danger of uneven settlement, according to the consulting engineer for the new twelve-story building of the Volunteer State Life Insurance Company at Chattanooga, Tenn. The specifications for this building were prepared with the purpose of allowing alternate bids on six different types of design. The contract price for the reinforced-concrete skeleton type, using a rich mix and vertical reinforcement for the columns, was $67,000 less than the lowest bid on the structural-steel frame type, using terra-cotta flat-arch floors. Part of this striking decrease in cost was due to the present high prices for steel and part to the relatively low cost of concrete materials and labor in Chattanooga. In order to profit by the low cost a rich mix, with comparatively small percentages of steel without spirals, was used in the design of the columns.

Concrete Cylinders to Rock

The building is 94 x 136 ft. in plan, located at the corner of Ninth Street and Georgia Avenue. At this site a stiff clay soil was found, overlying a sloping rock ledge to depths varying from almost nothing at the basement level at the south or Georgia Avenue end up to 30 ft. below this level at the opposite end. The problem thus arose whether to carry column loads partly on solid rock and partly on spread footings or whether to concrete to solid rock for all columns.

Owing to the nature of the soil, which was found stiff enough to stand vertically without any sheathing or bracing, and to act as a form for concrete, it was decided to dig circular wells to rock, then fill with concrete to a level of 3 ft. below the finished basement floor and carry the square columns on these cylindrical piers. The rock in the bottom of all wells was tested by drilling 4 ft. This scheme worked out economically, the cost being less than spread footings. No shoring whatever was used, except that in certain places a removable steel shield was lowered to protect the workmen against the danger of a cave-in.

The accompanying plan and elevations show the layout of these foundations, also details of cantilever footings along the rear wall and of beams connecting the footings with flared caps, which carry the double elevator columns. The cantilever beams were necessary because it was impossible to center the supporting cylinders under the columns along this rear wall without encroaching on adjacent property and disturbing an existing party wall.



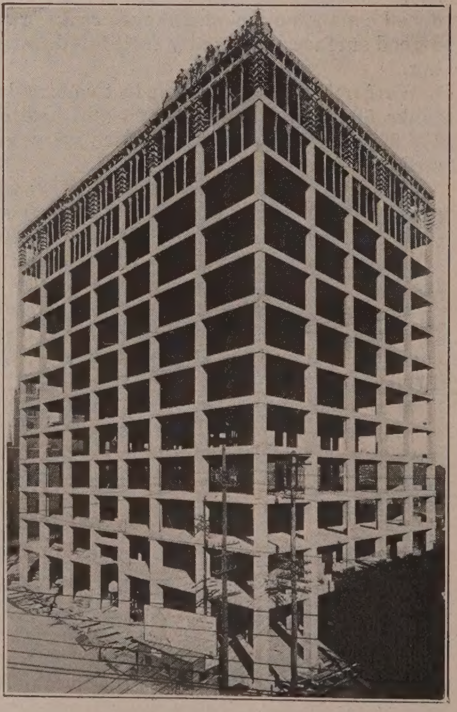
FOUNDATION PLAN OF CONCRETE CYLINDERS — DETAIL OF CANTILEVER FOOTING — FOOTING FOR ELEVATOR COLUMNS

COLUMN FOUNDATIONS OF CIRCULAR PIERS TO SOLID ROCK—CANTILEVER FOOTINGS

Six Different Bids

The specifications were drawn to invite bids for the structure above the foundations on six different types of design—(1) structural steel skeleton with terra cotta flat-arch floors; (2) structural-steel skeleton with reinforced-concrete and terra-cotta slabs; (3) reinforced-concrete skeleton with either reinforced concrete and terra cotta or metal floor slabs; (4) structural-steel frame with reinforced-concrete and metal-floor slabs; (5) structural-steel-concrete construction, "M-system" of the Standard Concrete Company, and (6) Metropolitan Fireproofing Company's system.

The lowest bids for each design were as follows: (1) $139,000; (2) $138,000; (3) $72,000 for the reinforced-concrete frame and terra-cotta floor slabs (awarded contract), and $69,000 with metal floor slabs; (4) $127,000; (5) $147,000, and (6) $155,000. The excess of $3,000 paid above the lowest bid was considered a good investment because the lower bid was based on using metal tile and expanded metal ceilings. The terra cotta was believed to be worth the difference on account of the impossibility of rust and no uncertainty as to its behavior when subjected to fire.



COMPLETING CONCRETE SKELETON OF TWELVE-STORY BUILDING IN CHATTANOOGA

Rich Mix Used

The principal element of economy in the adopted design lies in the use of a rich 1:1:2 mix in the columns up to the tenth floor, with a minimum of about 0.7 per cent of gross area of vertical reinforcement, and no spiral steel. The mix above the tenth floor was 1:1.8:3.7, and in the foundations the proportions were 1:2½:5. The largest columns are 42 x 42 in. in the basement, 36 x 36 in. in the first story with twenty-six 1-in. rods and 14 x 16 in. at the top, with four ¾-in. rods. All column ties are ⅜ in. round on 12-in. centers; the vertical rods lap 15 in. at splices, and dowels are 3 ft. long.

The construction proceeded at a rate of one floor a week, without night work. The foundations were built on a percentage basis before the contract for the superstructure was let. The Southern Ferro Concrete Company, of Atlanta, Ga., is the contractor for the reinforced-concrete skeleton. E. L. Meaders is superintendent, representing the owners, and William C. Spiker, their consulting engineer. The H. D. Watts Company, of Atlanta, has the general contract for the building, which will be the home office of the Volunteer State Life Insurance Company. Barnwell & Barnwell, of Chattanooga, are the architects.

Use Hardeners in Experimental Concrete Road in Louisiana

In an experimental concrete road in Louisiana at Baton Rouge there were applied to various sections hardeners of two types and hydrated lime. The concrete for this 9-ft. slab was a 1:1½:3 mix, and 10 per cent of hydrate lime was used in the last 600 ft. It produced a more dense and homogeneous mass and made the mixture more plastic and easier to work, according to W. E. Atkinson, state highway engineer, in his latest annual report. The curing was done under water and an unusual degree of hardness and toughness was obtained, so that the slab has shown few signs of chipping even on the edges of the pavement. To two 400 ft. of finished surface "Agatax," a liquid preparation, and Trus-Con Ironite Flooring, a metallic powder, were applied.

In a Good Dredge Crew Men Are Trained to Fill Positions Above Them

Attention to Men's Comfort and to Fact That the Average Man Will Not Stay Without Prospects of Advancement Increases Efficiency

By ARTHUR M. SHAW
Consulting Engineer, New Orleans, La.

[THIS IS THE SECOND *of a series of articles telling how dredging work is successfully conducted. The first article, published last week, dealt with the proper selection and use of the equipment. The third, to appear next week, will outline ways of keeping in close touch with the work.*—EDITOR.]

ATTENTION must be paid to the human element by anyone who expects to make a success of dredging work, as on it depends to a large degree the efficient operation of any type of dredging machine. This statement applies more closely, perhaps, to dredging work than to other classes of construction because of the smallness of the crews, the specialized duties and relative importance of each man and the less favorable living conditions in the way of isolation. Because of these conditions it pays to select men carefully and to train each man for the position above him, not only to avoid stopping the dredge every time there is a change in the crew but to let each man understand there is a better job ahead of him which it will pay him to stay and work for. Good meals and comfortable quarters, to which a reading room is an inexpensive but highly profitable adjunct, are also important considerations from this standpoint.

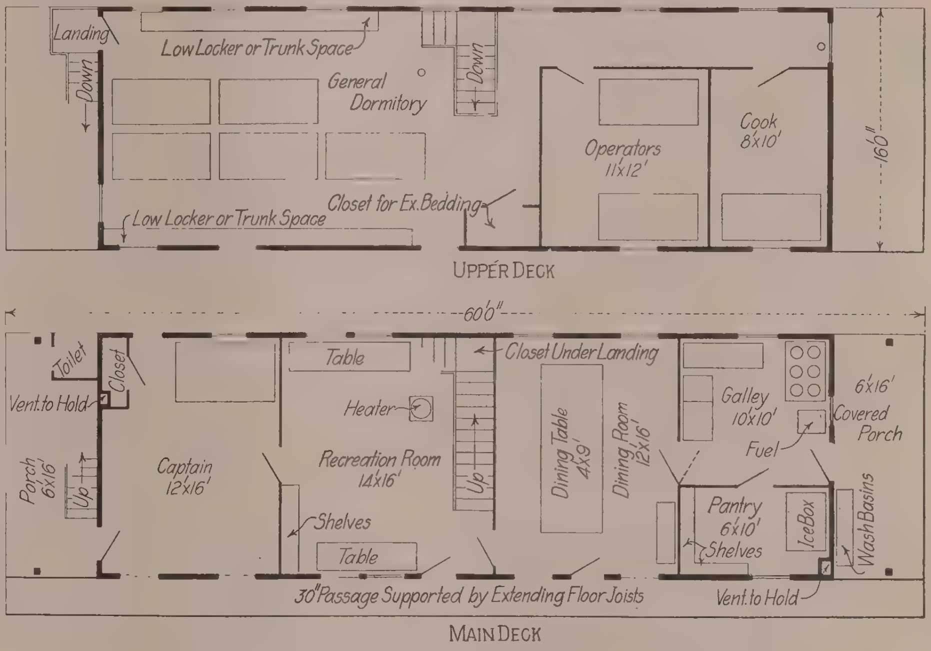
EACH MEMBER OF DREDGE CREW IMPORTANT

Special conditions, such as class of available labor, character of work and size of the dredging unit, largely dictate the organization to be adopted. The organization on an individual dredge will also be affected by its relation to other units under the same control. An isolated plant will require a higher grade man in direct charge than will one which is working in the vicinity of other dredges, all under the general supervision of a competent superintendent.

On a small dredge such as was described in the article on page 730 of the Engineering Record of last week, working as an independent unit, the writer has found the following organization well adapted to handle ordinary work, running on double shift: One superintendent, two operators, two firemen, two deckhands, one cook, one motorboat man and other labor as required for handling fuel, etc.

The superintendent has no fixed routine, but in addition to having general supervision of the plant and its operation he makes the more important repairs, acts as timekeeper and occasionally relieves the operators for short runs. So much depends on the ability and energy of the man in charge of such a plant that the greatest care should be exercised in his selection. He should not only be a good machinery man, with broad experience in making emergency repairs, but he should have good administrative ability. The handling of a small crew of men on a dredge may not appeal to most people as requiring administrative ability of a high order. Such a man, however, must not only keep account of his supplies, repairs required, time of men, amount of work done, condition of equipment, etc., but he must also act as buffer between employees and employer, control to a certain extent the menus served to the men, watch their health and often settle their personal differences, sometimes by moral suasion and at other times by force. He should be so familiar with the limitations and possibilities of breakdowns of his equipment that the occasion will be rare on which he will not be ready with new parts to replace any which may break, so that operation may be resumed with the least possible delay.

In addition to an ability and inclination to do their work efficiently, the operators should have, or acquire, such qualifications as may fit them for advancement to the position of superintendent should the occasion arise. In fact, every man in the organization, with the exception of the cook, should receive training and practice in the next position above that in which he is regularly engaged so that he will be in line of promotion. By following such a plan a dredging outfit need seldom be shut down because of illness or disability of any of the crew. Carrying such extra operators and other help does not add materially to the labor cost. It will often result in a better spirit among the men if those who have qualified for a higher position are recognized by a slight advance in wages and considered as extra operators, etc. This extra compensation should cover any apprentice work which they might do and short runs to relieve regular men, but as soon as they are advanced permanently the raise to higher pay should take effect. Any man who has not the ambition to advance is not worth keeping on the force.



NINE MEN MADE COMFORTABLE ON SMALL BARGE BY TWO-STORY HOUSE

The fireman, in addition to the ordinary duties attached to such a position, should take general charge of such machinery as may not be under the direct observation of the operator. At least one of the firemen should be qualified as an extra operator.

The deckhand is the general utility man. He assists in all repair work, helps in the care of machinery and does most of the cleaning up around the dredge. He should be given charge of the tool equipment and required to see that all tools are returned to their proper places as soon as the work on which they have been used is completed. While acting as helper on repair jobs he should gain a fair knowledge of blacksmithing, care of tools and other details which will be valuable to him as he advances.

GOOD MEALS WORTH CAREFUL ATTENTION

With proper conveniences, one cook should be able to prepare all meals for a crew of the size specified. He should provide wholesome food with ample variety. He should appreciate the difference between a generous and a wasteful table. A large stock of canned goods and dry vegetables should be kept on hand to provide against the inevitable breakdown in the supply line; but the cook should realize that food supplies may be obtained from other sources than tin cans. Where fresh vegetables and other supplies can be secured locally, the cook should be given reasonable latitude in making purchases to vary the menu. He should be required to render an account of the number of meals and lunches served each day. If the writer were not aware of the futility of putting such a clause into the specifications, he would also stipulate that the cook should have "a sweet and gentle disposition and an even temper."

Most floating dredges and some land dredges are served by power-boat tenders. These are usually gasoline launches and are used for hauling fuel and supplies and for towing. One man, with such assistants as he may require, should have entire charge of these boats and be responsible for their being in condition to give efficient and dependable service.

QUARTERS MERELY FOR EATING AND SLEEPING NOT SUFFICIENT

No attempt should be made to handle work of importance without providing comfortable and pleasant quarters for the men.

This should go farther than giving them just room enough for sleeping and eating. While the ordinary dredging job will not justify the installation of the elaborate libraries or clubrooms which have been furnished in some notable contractors' camps, some comfort and entertainment can be provided for the men even in the smallest camps and houseboats. Where, as is frequently done, camps for floating dredges are built on barges which have been discarded from other service, cramped quarters are likely to result. In such cases the necessary space may be provided by the construction of two-story camps. A barge 16 x 60 ft. will give ample facilities if the house has two stories. Although a wider barge would be preferable to insure stability and for other reasons, a barge of the above-mentioned dimensions will be sufficiently stable for use in all but open waters. Barges having a width greatly exceeding one-fourth their length are difficult to tow.

Double-Deck Barges Advantageous

Double-deck barges are hard to handle in a heavy wind, but the advantages which they offer are considered sufficient to outweigh such objections. The house should be built the full width of the barge and 48 ft. long, leaving an open deck 6 ft. in width at each end. A walk should be constructed along one or both sides of the barge for its entire length. This may be carried on an extension of the floor joists. The lower floor should be divided into a kitchen, pantry, dining room, reading room and captain's quarters. The stairway to the second story should come up from the reading room. The second story may be divided into separate rooms for the cook and operators, with a large dormitory for the other men, or, in hot climates, may be left as a single large room. The latter plan provides better sleeping conditions on account of allowing free passage of air. By placing a double row of double-deck bunks down the center of the dormitory, all windows may be left unobstructed and the space below them used for storing trunks or placing lockers, with room for hanging clothing on the wall between the windows. The double-deck bunks now on the market are both comfortable and serviceable. They are easily kept free from insects, an impossibility with wooden bunks.

Men Will Provide Own Literature

The reading room should be furnished with comfortable chairs, a large table for magazines and one or two writing desks. The management may well supply a reasonable amount of reading matter, such as a daily paper and one or two magazines, though if furnished with suitable facilities the men will provide themselves with such reading matter as they may require. The assortment of literature brought in by such men is interesting in its diversity. Included in such a list may be found poetry, light fiction, magazines, correspondence-school text books (especially those pertaining to mechanical drawing), machinery and tool catalogs and almost invariably catalogs of mail-order houses. Magazines, either new or back numbers, are especially favored.

In addition to the essentials, the captain's room should have a desk in which may be kept his time books, report forms and other supplies pertaining to his position. If he shows any aptitude at making drawings, a small drawing board with T-square, triangles and scale should be supplied. These implements, even in the hands of a novice, often enable him to give a clearer idea of repair parts which may be required than could be given by a bare written description.

An emergency cabinet should be kept in the captain's room and he should be instructed in its use. A very good outfit, packed in a metal case, may be secured for about six dollars.

By giving proper attention to the arrangement of its equipment, the kitchen may be made small. All reasonable conveniences, however, should be provided. Cheap stoves are a continual source of expense and annoyance and an element of danger. The heavy stoves such as are used in ocean-going vessels will be found more satisfactory than the cheaper substitutes.

A little attention to the comfort and welfare of the men forming a dredge crew is amply repaid in better service secured and greater freedom from continual changes in personnel. While it is true in some instances that men do not "appreciate decent treatment," as some employers complain, it is a fact that the average employee, especially of the grade of men making up a dredge crew, will give consideration to the efforts of his employer to improve the conditions surrounding the work.

Road Resistance Tested by Motor-Truck Runs

Results of Experiments Show Relative Values of Many Types of Surfacing for Delivery-Wagon Service

As the result of tests of the resistance offered to a ½-ton electric truck by different types of surfacing on level urban roads A. E. Kennelly and O. R. Schurig, in Bulletin 10 of the research division of the Massachusetts Institute of Technology, present the following enumeration of pavements in the order of their desirability for vehicle operation from the point of view of tractive resistance at a speed of 12.4 miles per hour: (1) Asphalt, (2) wood block, (3) hard, smooth macadam, (4) brick, (5) granite block with cement grouted joints, (6) cinder, (7) gravel, and (8) granite block with sand-filled joints. The experiments, which were first reported to the American Institute of Electrical Engineers, were such as to represent average conditions for ½-ton delivery-truck service with solid-rubber tires. Runs were made over selected stretches of road at nearly constant speed regulated by the controller, and successively in both directions for each controller point, thus covering a range of speeds. In reporting the results the authors state that tractive resistances are most conveniently expressed as equivalent percentage grades. In other words, a level road of definite tractive resistance may be regarded as a road of zero tractive resistance, but rising x units in 100 units of road length, or having an equivalent grade of x per cent.

Typical results for all classes of urban roads are summarized graphically in Fig. 1 and numerically in the table. It appears from these summaries that there are three principal elements which determine the tractive-resistance-speed curve for unit weight of a given vehicle, within the range of conditions covered by this test:

1. A constant resistance (see curve 1, Fig. 2) the magnitude *A* of which depends on the lack of resilience of the road surface and wheel tire material—that is, on the energy losses due to displacement of tire material and road-service material. This constant element *A* would be encountered upon a smooth level road of the particular type considered, in the absence of impact, air and wind resistance.

2. An increasing resistance with increasing speed, due to impact losses (Fig. 2, curve 2), which results from lack of smoothness of road surface. Losses of this nature are usually known to vary approximately as the second power of the velocity at impact.

Air Resistance

3. An increasing resistance with increased speed, due to air pressure against the front of the vehicle (Fig. 2, curve 3). This resistance is known to depend, roughly, on the second power of the speed. The sum of three curves of items 1, 2 and 3, for the case of asphalt roads, results in curve 4. The constant resistance, item 1, may be briefly called the displacement resistance, item 2 the impact resistance, and item 3 the air resistance. The displacement resistance is low for hard pavements and high for soft pavements of low resilience. The impact resistance is very marked in granite-block pavements. The air resistance, at any definite velocity, is the same for all curves, because the air-resisting parts of the truck were left unchanged throughout the tests. For the particular type of road represented by Fig. 2 (asphalt road in poor condition) at a speed of 12.4 miles per hour, the displacement resistance is equivalent to a grade of 0.84 per cent, the air resistance to a grade of 0.11 per cent, impact resistance to 0.20-per cent grade and the total to 1.15-per cent grade.

The displacement resistance of a road varies not only with the type and surface quality of the road, but also with the type,

Summary of Tractive Resistances of Different Urban Roads at Different Speeds
(All tractive resistances are expressed in equivalent per cent grade)

Road		Equivalent grade, per cent		Per cent increase in tract. resist. from 10 to 12.4 mi. per hr.	Comparative tractive resistance referred to asphalt roads	
Type	Condition	At 10 mi. per hr.	At 12.4 mi. per hr.		At 10 mi. per hr.	At 12.4 mi. per hr.
Asphalt	Good	0.93	0.97	4	1.0	1.0
Asphalt	Poor	1.03	1.16	11	1.11	1.20
Wood block	Good	1.10	1.15	5	1.18	1.18
Brick	Good	1.12	1.21	8	1.20	1.25
Brick	Slightly worn	1.14	1.27	11	1.23	1.31
Granite	Good	1.83	2.16	18	1.97	2.23
Granite, cement joints	Good	1.16	1.37	18	1.25	1.41
Macadam, waterbound	Dry and hard	1.06	1.17	10	1.14	1.20
Macadam, waterbound	Fair, heavily oiled	1.63	1.76	8	1.75	1.82
Macadam, waterbound	Poor, damp, some holes	1.65	1.89	15	1.78	1.95
Tar macadam	Good	1.17	1.27	9	1.26	1.31
Tar macadam	Very soft	1.67	1.76	5	1.80	1.81
Tar macadam	Many holes, very poor, soft	2.38	2.75	16	2.55	2.85
Cinder	Fair, hard	1.25	1.39	11	1.35	1.43
Gravel	Fair, dusty	1.37	1.50	9	1.47	1.55

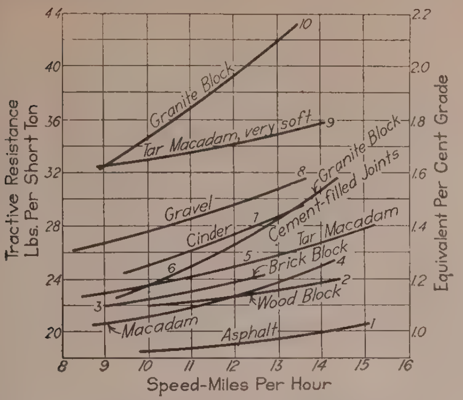


FIG. 1—SUMMARY OF TRACTIVE RESISTANCE TESTS FOR VARIOUS TYPES OF SURFACING

dimensions and quality of the tires on the wheels of the vehicle. In the tests here reported the same tires were used throughout, and they remained in substantially the same condition.

The impact resistance of a road depends not only on the type and surface quality of the road and the sizes of its irregularities, but also on the type, dimensions and quality of the wheel tires, the weight of the truck, and the quality of its springs.

The air resistance per unit weight of truck depends upon the weight, dimensions and shape of the vehicle, as well as on the direction and velocity of the wind and the velocity of the vehicle. It is assumed that at low wind and vehicle speeds, like those here considered, only that component of the wind which is in the direction of the vehicle's path needs to be taken into account, and that the mean of the wind resistances in opposite directions, along the road, is zero.

The following studies are suggested for future experimenters along the line of this investigation: (1) Researches on vehicle tractive resistances on country roads; (2) tractive resistances to vehicles with different wheel tires; (3) tractive resistances of urban roads at low speeds from 0 to 10 miles per hour; (4) tractive resistances at speeds higher than 15 miles per hour; (5) tractive resistances for heavy-duty trucks

SUMMARY OF CONCLUSIONS

The displacement resistance varied from 0.85 per cent equivalent grade, for a hard, smooth asphalt or bituminous concrete, to 1.6 per cent for a very soft tar-macadam road, and was practically constant, for all speeds considered, on any given road.

The impact resistance increases with the velocity, with the total weight of vehicle, and with increasing road surface roughness. In these tests the impact resistance of good asphalt or Bitulithic or other smooth pavement was practically negligible, and reached its highest values on granite-block roads with sand-filled joints, and on badly worn macadam pavements. The rate of increase of impact resistance with speed was most marked on the roughest roads.

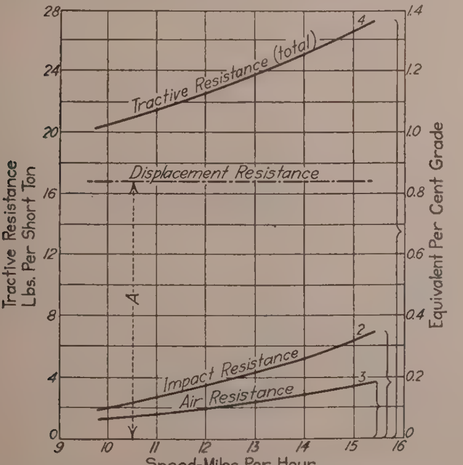


FIG. 2—ANALYSIS OF TYPICAL TRACTIVE RESISTANCE INTO ITS ELEMENTS FOR ASPHALT ROAD IN POOR CONDITION

At the vehicle speed of 12.4 miles per hour the air resistance for the vehicle tested, assumed to be dependent only on the speed, was roughly 0.11 per cent equivalent grade—that is, from 4 per cent of the highest to 12.5 per cent of the lowest total tractive resistance.

The equivalent grade at 12.4 miles per hour of a badly worn city macadam road was found to be nearly three times as great as that of the best asphalt road tested.

Increasing the gross weight of the vehicle by 12 per cent, through load, was found to have no effect on tractive resistance within the observed speed limits for smooth roads in good condition; but on rough roads a distinct increase in tractive resistance with this extra weight was observed.

The presence of a layer of dust, say 1 cm. thick, on a fair macadam road was found to increase the equivalent grade of tractive resistance, at all tested speeds, by about 0.15 per cent.

A freshly tarred, and therefore very soft, tar-macadam road was found to have an increased tractive resistance equivalent, at substantially all tested speeds, to about 0.5 per cent. The tires in this case sank about 0.8 in. into the road bed, the gross car weight being 4710 lb.

The total range of tractive-resistance equivalent grade covered in the tests was from 0.93 per cent on the best asphalt road, at lowest speed, to 2.7 per cent on the worst macadam road, at nearly the highest speed.

Retaining-Wall Formula Corrected

An error due to inadvertence on the part of the draftsman was made in Case 3 of Table 1 of T. A. Smith's article on retaining-wall formulas appearing on page 564 of the issue of Nov. 4. The value of A should be $7y/2 + 2t$ instead of $y/2 + 2t$.

Tractor and Trailers Haul 136 Tons of Ore in 5½ Days

Thirty-Two-Mile Round Trip Over Rough Road Through Utah Mountains Made Twice a Day with Loads Under Perfect Control

ANOTHER demonstration of the fact that motor-traction equipment may be relied on to solve the transportation problem where large tonnages must be transported through territory in which railroad construction is extensive was afforded recently, it is reported, in the Big Cottonwood district of Utah by the gasoline trailer outfit shown in the photograph. This equipment was used in an eleven-trip demonstration, during which 272,660 lb. of ore was hauled 16 miles from the Cardiff Mines to Sandy, and 27,080 lb. of coal was hauled to the mine on the return trip. The ore bins at the mines where the trucks are loaded are 3050 ft. above the smelters at Sandy, 16 miles distant, and the greater part of the rise occurs in the last 9 miles of the trip, the lower 7 miles of the road being across a fairly level valley. Two round trips a day were made over this route, with a total of 3 hours to spare for inspecting and oiling the equipment. During the demonstration the gasoline consumption averaged 21 gal. per round trip, and the oil used averaged 2 quarts.

OUTFIT AVERAGED 10.4 MILES PER GALLON OF GASOLINE HAULING ORE IN ROCKIES

It is stated that in spite of the great rise, including one grade of 16 per cent, and in spite of the fact that as much as 4300 lb. of coal was hauled on several of the return trips up grade, it was not necessary during any of the demonstration trips to add water to the radiator on account of heating. The equipment with which the demonstration was made consisted of one Knox tractor equipped with a 5-ton ore body and two rubber-tired Troy trailers, each with a capacity of 5 tons.

Equipment of this type is now being used exclusively by the United States Transportation Company, which hauls the ore from these mines on contract. Teams had formerly been used for this purpose, and it is stated that single-unit motor trucks had been tried before the present equipment was decided on. The tractor outfit handles a much larger tonnage with one power unit.

Unified Traction Plan for Chicago Will Pull Out Sides of Elevated Loop

Nine-Year Program, Involving $100,000,000, Laid Out by W. B. Parsons, Robert Ridgway and B. J. Arnold, of Traction and Subway Commission

UNIFICATION of all traction facilities in Chicago, revamping of the present elevated system into a complete rapid-transit system, and a "pulling out" of the loop in all directions are probably the three fundamental considerations which have governed the $250,000 Chicago Traction and Subway Commission in its study. William Barclay Parsons, Robert Ridgway and Bion J. Arnold are the members of the commission; Henry M. Brinckerhoff is the chief engineer, and Herbert Evans is the secretary. Only the general plans and conclusions are available; the great mass of supporting data will come later in a supplemental report. The following abstract is taken from the advance proofs of the commission's report. The work of construction is divided into three consecutive periods. At the end of the ninth year, when $100,000,000 shall have been spent, the results will be as follows:

RESULTS OF IMMEDIATE CONSTRUCTION

1. Conversion of the elevated lines now giving principally local service into structures capable of furnishing extended high-speed express service.
2. Amplification of main lines and terminals, giving two and one-half times the present maximum rush-hour capacity.
3. Rapid-transit routes giving transfers between all outlying parts of the city without the present necessity of passing through the Loop district.
4. Two-way operation on the Union Loop and on all other rapid-transit routes, with direct transfer to all parts of the city.
5. The expansion of the Loop district in all directions.
6. The elimination of five grade crossings on the elevated structures.
7. Improved stub terminal rush-hour service from three sides of the Union Loop.
8. Extensive outlying territory given rapid-transit service directly or by transfers from the surface lines.
9. Subways carrying most of the West Side surface cars underground through the Loop district to Michigan Avenue, thus removing them from the surface of the street and thereby reducing congestion.
10. Surface-car subway from the south, reducing congestion on State Street and Wabash Avenue and connecting with the West Side subway, providing a much-needed service directly connecting the main railroad stations.
11. All transfer facilities as they now exist to be maintained and in addition transfer facilities between surface and rapid-transit lines are to be given for an additional charge over the present single fare or considerably less than the sum of the two fares now paid.

LIMITATIONS OF LOOP DISTRICT REMOVED

It will be seen that while all the facilities to the district now known as the Loop have been preserved, the limitations due to transportation in this district have been removed, and that its extension has thereby been facilitated in three directions—north, west and south. Not only does the new system provide for greatly increased through running, but facilities for delivery have been provided into new districts north and west of the river and south of Van Buren Street, into which the business of the so-called Loop is now tending to spread and which spreading will be encouraged if satisfactory facilities are afforded. The expansion of this district will be of benefit not only to the localities named, but to Chicago as a whole.

PRESENT AND PROPOSED LOOP DISTRICT

The area now directly served by the Union Loop tracks is about 1½ sq. miles. The system of tracks proposed in this report will at once broaden the downtown district in three directions to over five times the present area. The straightening of the river would open new thoroughfares and would materially assist in solving Chicago's transportation problems.

Starting with present traffic conditions, the study of the city's future transportation needs has been made in an effort to so adjust the plans for immediate improvements as to meet future probable developments and stimulate growth in desirable directions.

On the elevated lines, for a complete twenty-four-hour period, tickets were issued to all passengers at points of origin and collected where they finally left the system, thus tracing the entire trip of each passenger, including the transfer from one line to another. The patrons of the lines co-operated to such an extent that 499,826 passengers were separately identified on a single day, or 93.5 per cent of the total travel on the day in question.

WHAT TRAFFIC CHECKS SHOW

The traffic checks show that 60 per cent of the total elevated-railway passengers are handled between the hours of 6 to 9 a. m. and 4 to 7 p. m.; that 63 per cent of the total passengers in twenty-four hours are hauled to and from the Loop district, while 25 per cent of the total travel originates and ends on the individual lines. Only 12 per cent of the total all-day and rush-hour elevated passengers ride through or transfer across the Union Loop, the percentage of total traffic during the rush periods being less than this figure. The average length of journey is found to be 6.48 miles, which is a much longer distance than the average haul on the elevated and subway lines in New York; the former being 4.16 miles and the latter 5.57 miles (calculated from 1915 ticket sales).

On the surface cars, checks were made covering the principal lines on which more than three-quarters of the total surface traffic is carried, and including the tracing of all passengers individually to the points where they first transferred, and of all large transfer groups through points of transfer to their destination.

A combination of the haul on originating lines with the transfer haul indicates that the average journey of the passengers carried on the surface lines for a single fare was 4.16 miles. This also is in excess of the length of the average ride in other large cities.

A canvass was made of the industrial and commercial establishments having more than 100 employees as to their residential and occupational locations. Of the total of 350,007 employees located, 23.9 per cent are found to live within walking distance of their places of employment. Deducting this percentage from the total and assuming that the remaining 76.1 per cent ride twice daily to and from their places of employment, it is found by a comparison with the total rush-hour traffic of the surface and elevated lines that we have definite information upon 50 per cent of the traffic. The importance of this is shown by a study of the charts developed, which indicate clearly the districts to and from which transportation is distinctly lacking and the districts that must be reached by circuitous or indirect routes. It is believed that this determination of 50 per cent of the rush-hour business is so truly representative as to be a very safe basis upon which to analyze the present traffic conditions as to origin and destination.

RESULTS OF LOCATION CANVASS

The results of the various investigations covering the characteristics of the traffic on the surface and elevated lines, as well as the residential and occupational location of rush-hour travelers, clearly point to the fact that the present prevailing transportation characteristic of Chicago is that of a city with a central delivery district of relatively small area and a number of minor delivery districts widely separated from this principal district.

Into the Central district, which has an area of 5 sq. miles, 48 per cent of the 350,007 workers located are delivered daily. As this district is only 2½ per cent of the total area of the city, the degree of concentration is seen to be very marked.

Extending this area progressively north, south and west, so as to include various districts of increasing size, it is found that into 23 sq. miles bounded on the north by Diversey Parkway, on the south by Twenty-sixth Street, and on the west by California Avenue, 63 per cent of these rush-hour travelers are delivered, this district being 11.5 per cent of the city area.

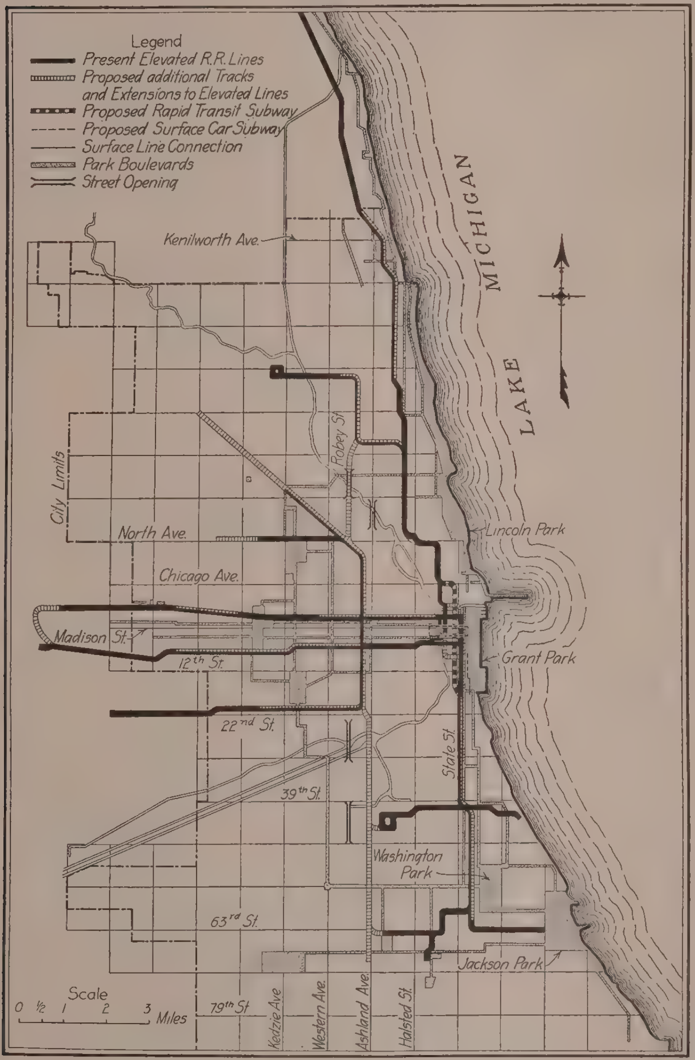
ANALYSIS OF MEDIAN LINES

Following this idea in another connection, an analysis was made of the median lines of residence and of occupation. If on a map of Chicago a line is drawn, located so that there are just as many people living due east of any point along it as due west, the line drawn is the median line of residence. Such a line will be found to be practically parallel to the lake front for the whole distance and from 2 to 3 miles west of it. A similar line drawn so that the number of people working due east of each point is the same as those due west would be the median line of occupation. Everywhere except at the middle the median line of occupation follows the same general direction as the median line of residence, but at the middle it bulges sharply toward the downtown business district until it almost touches the edge of the Loop. This is due to the ever-growing volume of business transacted in the downtown district and to the light manufacturing district increasing so rapidly at its edges.

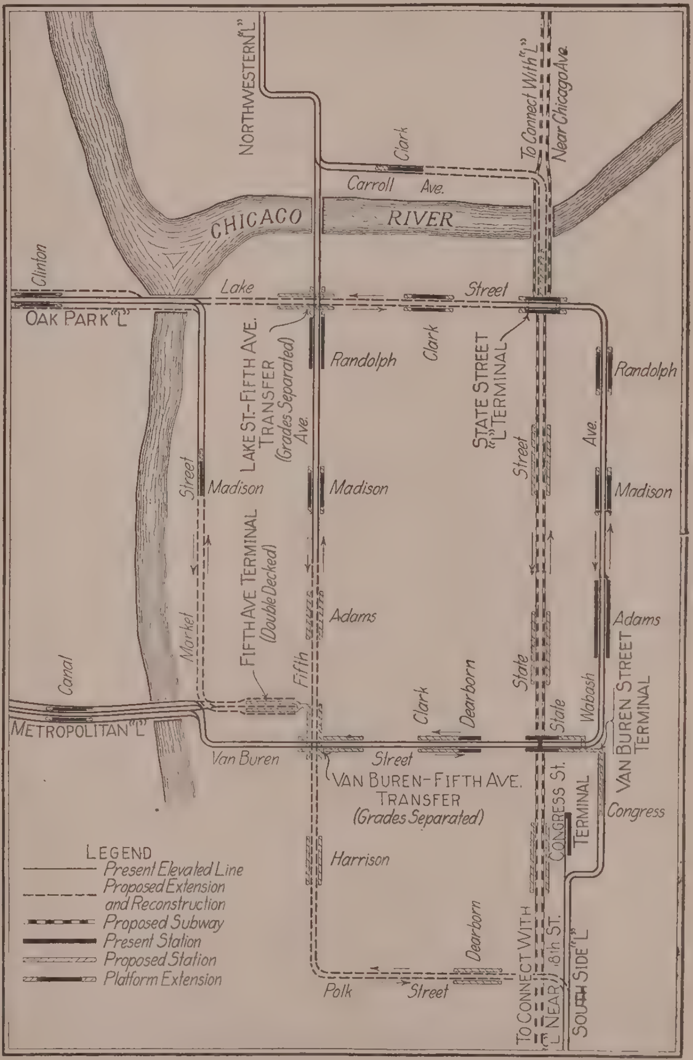
With this district continually growing, the population is steadily moving westward. In time the bulge may be expected to become greater as the population curve travels westward, although as the downtown district grows north and south, the bulge will widen out at the ends and become less abrupt.

The bulge in the occupational median shows clearly why so many West Side lines have to focus into the downtown district, while the closeness of the occupational and residence curves at the ends shows why special routing is not generally required in those localities.

An analysis of the occupational distribution north and south of a median line shows this line passing in a general way east and west through the center of the central business district with a southwesterly tendency as it progresses west from the Loop district.



PRESENT AND PROPOSED RAPID-TRANSIT SYSTEM WILL TAKE NINE YEARS TO BUILD



PROPOSED SYSTEM FOR BUSINESS DISTRICT WOULD STRETCH LOOP ON ALL SIDES

LOOP NO LONGER THE WHOLE BUSINESS DISTRICT

The designation of Chicago's former Central business district as the "Loop," which term originally applied strictly to the area within the Union Elevated Loop, is no longer at all descriptive and inclusive of the city's present central business area. This district, which was originally physically bounded on the north and west by the river, on the east by the lake and on the south by the steam railroad yards below Polk Street, has now spread beyond these limits, so that a marked growth is found southerly along Michigan Avenue, Wabash Avenue, and State Street, and also north and west of the river. Of the 115,085 employees located by the survey in this original Loop district, 36 per cent were found outside of the elevated Loop structure.

The term "Loop district" refers to the area south and east of the river and north of Polk Street, while the term "Central business district" applies to the wider area which at present extends from Division Street to Twelfth Street and from Lake Michigan to Racine Avenue. The Loop district is rapidly expanding into the Central business district, and that district will in the future expand beyond the limits stated above if supplied with transportation facilities.

What is needed is briefly:

1. To provide main rapid-transit lines that will serve all parts of the city, distribute traffic, relieve congestion and carry people to and from all the business districts of the city, whether central or outlying.

2. To provide rapid-transit routes outside of the Loop district, enabling through passengers to travel direct, without being unnecessarily diverted into or through this district, and to give direct facilities to outlying centers.

3. To provide additional and better means of travel through the Central district with a view to broadening its area.

4. To relieve surface congestion wherever necessary and carry as many West Side cars to the lakefront as practicable by subways in the Loop district.

5. To provide express service, by the addition of third and fourth tracks, on all parts of the rapid-transit system.

6. To regulate properly street vehicular traffic.

Some of the facilities to be built must be subways, others should be elevated structures, while a few can be formed by a combination of both types. It is to be borne in mind that a subway costs about four times as much per mile as an elevated railroad and that it will furnish no more passenger carrying capacity, speed or other advantages than the former. By its extra cost it absorbs additional capital and so limits extension of other lines and curtails the sum total of the possible supply of service if built where an elevated railroad is permissible.

THE REMEDY

A summary of the recommendations was printed in the Engineering Record of Dec. 9, page 723.

The general plan which the commissioners recommend has in view a development along the following broad lines, which as a primary basis will require the construction of four north-and-south rapid-transit lines parallel with the greater dimension of the city. Two of these lines will pass through the present Loop district and the other two will be located farther west on Halsted Street and Ashland Avenue. The east-and-west rapid-transit lines extending from the outer limits of the city to and through the greatly broadened Central business district will intersect the above-mentioned four lines, with transfer arrangements at points of intersection.

This rapid-transit system is to be extended, as may be necessitated by the city's growth from time to time, so as to serve the new and growing subcenters and residential districts. Elevated platforms are to be lengthened and at convenient points transfer is to be provided from the surface lines to the rapid-transit lines.

DIVERT LONG-HAUL QUICKLY TO RAPID-TRANSIT SYSTEM

It is proposed to install a system of transfer from the surface cars to the elevated and subway lines so as to divert the long-haul travel from the surface to the rapid-transit lines, the surface lines being used as pick-up or feeder lines in the residential districts, transferring to the rapid-transit system the passengers who have long journeys to make. It has been found that this can be accomplished and rapid-transit service offered to greatly extended areas in the city by the establishment of certain transfer stations in outlying districts where radiating lines of surface cars can deliver passengers directly to elevated trains, in some cases across platforms at the same level.

In laying out the general plan for the subways in Chicago, it has been necessary to use two levels, one for the north and south and one for the east and west subways. In order not to destroy the Illinois tunnel, it has been necessary to keep the upper level closer to the surface of the street than in the opinion of the commissioners would otherwise be desirable. In order to avoid this necessity in future subway construction, the Illinois Tunnel Company should be required to build all its tunnels hereafter so that the clearance between the tunnel structure and the street surface should be not less than 38 ft.

CHICAGO'S SUBSURFACE

The subsurface material of the business district of Chicago consists in general of a top layer of non-homogeneous sandy loam and clay (largely débris and fill) of approximately 15 to 20 ft. in thickness, underlain by a homogeneous clay, varying in bearing power with the degree of moisture involved, but decreasing in moisture until it becomes very compact before reaching the rock overlay. This overlay, consisting of hardpan, sand pockets, and miscellaneous deposits, is at so great a depth beneath the surface as not to be a factor in the construction of underground railways.

The clay stratum at the proposed subway depth is not of so satisfactory a character for excavation along streets lined by heavy buildings as would be rock, dry sand, hardpan, or dry clay. With the exercise of care, however, subways as proposed can safely be constructed. The necessary precautions will add to the cost, which addition has been included in the estimates, and these same precautions will require the use of other construction methods than have been adopted in cities where the subsoil conditions are radically different from those found in Chicago.

In planning for subway construction, the commissioners have carefully considered the necessary readjustment of the sewers, the water, and gas mains, and other utilities affected. In the Loop district the high-level subways will be so close to the street surface that it will be necessary in places to provide chambers or galleries to take care of these utilities, particularly at some of the street intersections. As to whether public-utility galleries should generally be constructed in connection with the transportation subways, the commissioners express no opinion for the reason that the determination of the advisability or non-advisability of the general construction of public-utility galleries depends upon considerations that have no necessary connection with the transportation problems (except as noted) to which the work of the commission has been specifically confined by the ordinance.

The initial downtown terminal construction program provided for is designed to utilize to the best advantage all existing track capacities, both elevated and surface, and in the location of the subways necessary for adding to the terminal capacity of the elevated lines the controlling consideration has been the necessity for avoiding the use of the underground space in the main streets of the Loop district for such short connecting subways. The Loop district of Chicago is very much like the south end of Manhattan Island in New York, where it is already necessary to reserve every street for a through line, and in some cases for both elevated and subway. Chicago when embarking on a liberal plan for future rapid-transit lines should jealously guard against unnecessarily occupying any subsurface street space in the downtown district for the reason that it cannot possibly be foreseen to what extent or where such space may be needed for through service connecting the outlying parts of the city.

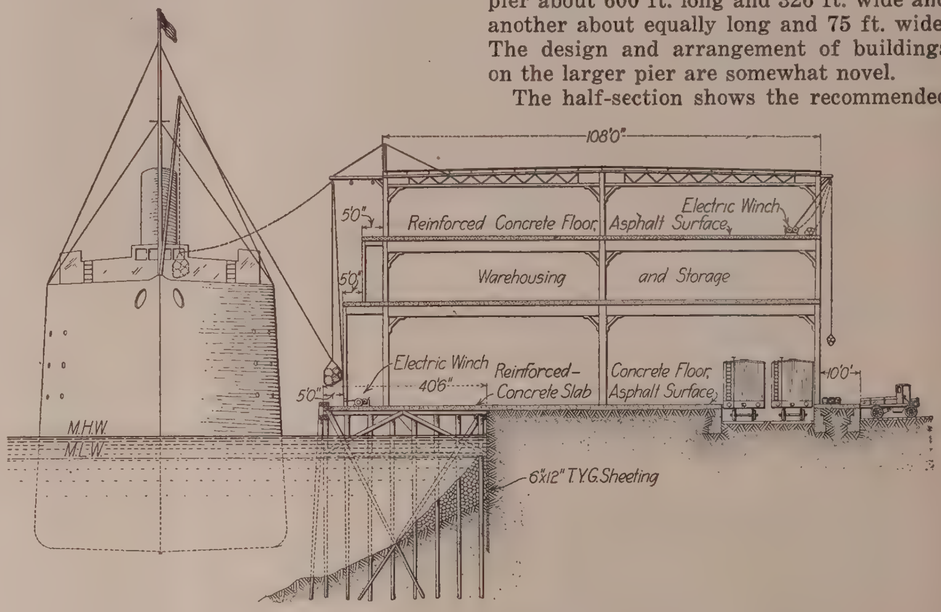
Building in San Francisco Since 1906

Since the fire of 1906 the city of San Francisco has issued a total of 66,278 permits for building construction, the value of which was $292,846,885. The permits include 211 Class A buildings, 221 of Class B and 3101 of Class C. The figures also include eighty-three exposition buildings.

Combination of Piershed and Warehouse Proposed

For Municipal Wharf at Camden, B. F. Cresson, Jr., Recommends Three-Story Sheds, Each Floor Stepped Back at Water Side

A COMBINATION of piershed and warehouse is a feature of the plans proposed by B. F. Cresson, Jr., chief engineer of the New Jersey State Board of Commerce and Navigation, as the first step to be taken by Camden, N. J., for the development of its waterfront. The development proposed, mentioned in a news note in the Engineering Record of Dec. 9, page 724, would be at the foot of Spruce Street. Mr. Cresson recommends the construction of two piers, together with suitable rail connections and a small switching yard. He proposes one pier about 600 ft. long and 326 ft. wide and another about equally long and 75 ft. wide. The design and arrangement of buildings on the larger pier are somewhat novel.



HALF-SECTION OF PROPOSED PIER, WITH COMBINATION PIERSHED AND WAREHOUSE

The half-section shows the recommended arrangement. Along each side of the pier would be a three-story building 118 ft. wide at the lower floor. The lower floor would have a headroom of 22 ft., and would be used for the ordinary purposes of transshipment. On the water side would be a 5-ft. platform. Just inside the driveway side of the building would be two railroad tracks, sunk to bring the floors of cars level with the floor of the building. Between the two buildings would be a space of 80 ft., divided into a 60-ft. roadway and two 10-ft. platforms. The two upper stories of the building would each be 12 ft. high in the clear. Each would be stepped in 5 ft. on the water side to allow a working platform. Hoists carried on overhanging arms and operated by electric winches, working with the ship's tackle, would permit easy transshipment of cargo between vessel and any floor of the shed, while other hoists on the inner side of the shed would raise and lower the cargo between the outside platform and either of the upper floors.

With such an installation, the report points out, trucks may drive upon the lower deck of the pier, where they may deliver cargo to or receive it from ships. Cargo coming from ships to railroad cars may be trucked directly across the floor of the pier and into the body of the car at the same level as the pier's floor, and a reverse course for cargo going from the railroad cars into sheds will be followed.

Cargo received from ships for storage

will be unloaded directly upon the platforms of the second or third floor by means of the ship's tackle and the cargo hoists. Cargo from the warehouses going into ships will be unloaded from the platforms along the edge of the pier into the ship in similar manner. Cargo from the warehouses to railroad cars will be lowered from the doors of the warehouses on the street side to the narrow platform to the rear of the shed and from these platforms into the body of the railroad car on the level of the platform. Cargo from the warehouses to trucks will be lowered in a similar manner to the platform and directly into the trucks.

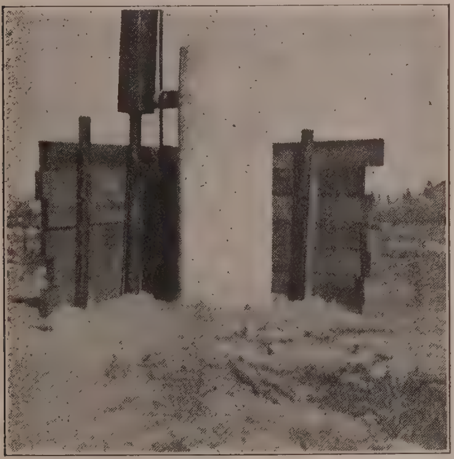
It is proposed to make the wide pier solid fill, but in order to lessen the cost the outer 40 ft. is to be carried on timber piles, the fill to be held by timber sheeting as shown. The half-section is taken midway between bents. All columns would be supported by concrete pedestals carried on piles surmounted by timber platforms at mean low water. A 10½-in. concrete floor slab would be carried the full width of the lower floor.

Wells Protected from Flood Damage by Wedges

City of San Diego Installs Wooden Barriers as Safeguards Against Floating Débris and Scour

By A. C. FRANCIS
Operating Department, San Diego, Cal.

BECAUSE of flood damage done during the storms of January, 1916, San Diego, Cal., found it necessary to rebuild the entire field plant of the Mission Valley pumping station, a 5,000,000 gal. capacity auxiliary pumping station in the bed of the San Diego River. Of the twelve wells in operation before the flood only three were recovered. Accordingly nine new wells were drilled and an air-lift system of transmission of the flow from the wells to the plant installed, which takes the place of the individual pumps and motors located at each well prior to the destruction of the plant.



WEDGE-SHAPED BARRIER PROTECTS SAN DIEGO WELLS FROM FLOOD DÉBRIS

In order to protect the wells from being torn out during stormy weather by floating débris, the Operating Department, under the direction of City Manager F. M. Lockwood, has placed a wedge constructed of heavy timber and railroad iron in front of the wells, with the nose pointed upstream. Three 30-lb. rails were driven to a depth of about 24 ft. in the sands, and the wedge was constructed around these rails out of 3 x 12-in. planks 12 ft. long. The wedge extends 6 ft. below the surface of the sand and 6 ft. above, thus protecting the wells both from shifting sands and floating débris upon the surface of the stream.

The cost of the entire reconstruction was about $26,000. Nearly $5,700 was spent in attempting to relocate and recover the old field plant and in general reconstruction. The air-lift system cost $11,270; the new wells, $8,069; a survey of the property, $356, and the wedges to protect the wells, about $700.

Flood Control Will Make Waste Land Factory Sites

City Plan Commission of St. Louis Reports on $8,000,000 Industrial Development Project for River des Peres

EXTENSIVE tracts of idle land in St. Louis, Mo., will be made available for industrial and residential use if the flood-control and improvement project for the River des Peres, upon which the City Plan Commission has just reported, is put into effect. The work will cost about $8,000,000 and will involve the construction of a river channel and sewer, a railroad to complete the belt line around the city and a scenic driveway. It is planned to open up an area of 950 acres for industrial development and, by means of the proposed railroad, to divert through freight around the city rather than into the congested Mill Creek Valley, as now done. From the report of the City Plan Commission, for which Harland Bartholomew is engineer, the following details regarding the project have been taken:

MORE INDUSTRIAL SITES NEEDED

St. Louis has experienced, like all other cities, a certain haphazard growth. This indiscriminate expansion has produced uneconomic conditions which to-day are being realized in an apparent or threatened decline in the rate of increase of the city's population and industry. It cannot be said that reaction has set in, yet it is a well-known fact that rapid growth of population and industry is taking place in neighboring cities across the Mississippi River and St. Louis County, all of which are within the metropolitan district.

Locations for these increasing metropolitan activities are selected outside instead of within the city, because St. Louis cannot at present offer such cheap, attractive and available residential and industrial sites. If St. Louis is to benefit from the increases for which it is primarily responsible, and grow as other large cities are growing, it must take immediate steps to place on the market the advantageous areas within its bounds and to make these areas so attractive to prospective industries and residents that they will not consider going elsewhere.

STORM WATER AND SEWAGE

The existence of the River des Peres in its present state is partly responsible for the uneconomic development of St. Louis. Because of floods it has rendered useless extensive tracts of land which should long ago have been converted to industrial use. Because of offensive odors it has rendered unfit for residence purposes much excellent adjacent territory. To dispose of the storm-water and sewage problems of the River des Peres is the first step in the development of the River des Peres Valley, and the development of the River des Peres Valley would immediately create additional and sorely needed room for the industrial and residential expansion of St. Louis.

Plans for a complete storm-water and sewage system have been prepared as follows:

OPEN CHANNEL

From the Mississippi River to the several forks of the River des Peres in Maplewood there will be an open channel 160 to 180 ft. in width and 18 ft. deep, built of reinforced concrete. This channel will follow approximately the line of the foul-water sewer already there. The foul-water sewer is of sufficient size to dispose of the dry-weather flow. The channel will be of adequate width and depth to carry off the floods caused by excessive rainfall. From Macklind Avenue to the forks in Maplewood there will be a channel about 80 ft. wide and 16 ft. deep. Beneath this will be constructed a foul-water sewer to carry dry-weather flow, the sewage and storm water both now being carried off in the present open channel of the River des Peres. From Macklind Avenue to the Mississippi River the open channel will be of sufficient grade and easy curvature to permit direct flow and thus eliminate all stagnant water now caused by the extremely irregular course of the present stream. While the open channel will be dry and clean, except at times of heavy rainfall, it can, if necessary, be covered over at some subsequent date without unusual added expense. From Macklind Avenue to Union Avenue in Forest Park there would be a double section reinforced-concrete sewer, each section being from 27 to 30 ft. wide by about 22 ft. high. From Union Avenue to the city limits in Hodiamont there would be a single section reinforced-concrete sewer about 30 ft. wide by 23 ft. high. These sewers would carry off such extensive rains as the two in 1912 and the long rain in August, 1915.

The total estimated cost for the relief of sewage and storm-water troubles in the River des Peres Valley, including open channel from Mississippi River to Macklind Avenue, closed sewer from Macklind Avenue through Forest Park to the city limits, foul-water sewer from Maplewood to Macklind Avenue, reconstruction of bridges, purchase of right-of-way and necessary extensions and connections, is $5,815,450.

It is proposed to pay for the River des Peres sewer and channel entirely by bond issue. It would be the city's largest outlet sewer and therefore a public sewer which should be paid for by the city at large. Furthermore, in the River des Peres Valley only 11 per cent of the cost of all sewers has been paid by the city, or $89 out of every $791 per acre of cost.

A MUNICIPAL RAILROAD

As a part of this River des Peres plan a municipal railroad is proposed from the levee at the mouth of the River des Peres to the Frisco and Terminal Railroad intersection at Maplewood. The two chief benefits to be derived from such a system as described would be (1) the opening up of large areas, now idle, to good industrial use, and (2) an opportunity to direct through freight around the city rather than into the congested Mill Creek Valley, as is now done. The total cost for the construction of the railroad, including right-of-way, grading, culverts, bridge construction, paving, track work and all related items, is $526,615.

From the Frisco Railroad in Lindenwood east as far as Morganford Road there is a strip of property between the city line and the proposed channel which varies in width from 150 to 800 ft., being about 200 to 300 ft. wide on the average. This land is mostly unused. With the proposed improvements of channel and railroad it would still be of little use for residence or industry, due to inaccessibility and its steep slope toward the river channel. Because of its natural attractiveness, its use for park purposes is suggested. The very limited width, however, would indicate that a drive, rather than a number of disconnected parks, could best be built.

The estimated cost of the driveway and adjacent park land, 280 acres in all, bridges, grading, paving and parking complete, is $1,277,668.

The total cost of the River des Peres plan is $8,019,118, divided as follows:

Open channel, closed sewer and all other related construction	$5,815,450
Double track industrial railroad complete	526,000
Driveway from Kingshighway southwest to McCausland Avenue and Manchester	1,277,668
Ivanhoe Avenue — McCausland viaduct (city's share)	400,000
Total	$8,019,118

It is proposed that the entire sum should be raised by a bond issue, the term of which must be 20 years, according to the present limitations of the state constitution. Approximately 72 per cent of the entire cost of the proposed plan is for the sewer and channel which the city must soon construct. When it is considered that for an additional 28 per cent ($2,203,668) untold benefit can be derived in the opening up of idle territory to industries and residence, with highly desirable railroad facilities, a complete circuit driveway and a good street plan, the necessity for simultaneous action on all projects seems obvious.

Special Details in Erection Reduce Secondary Stresses in Longest Simple Trusses

Phosphor-Bronze Bearing Blocks and Steel Castings Allow Rotation in Two Directions During Erection of 720-Foot Span of Metropolis Bridge

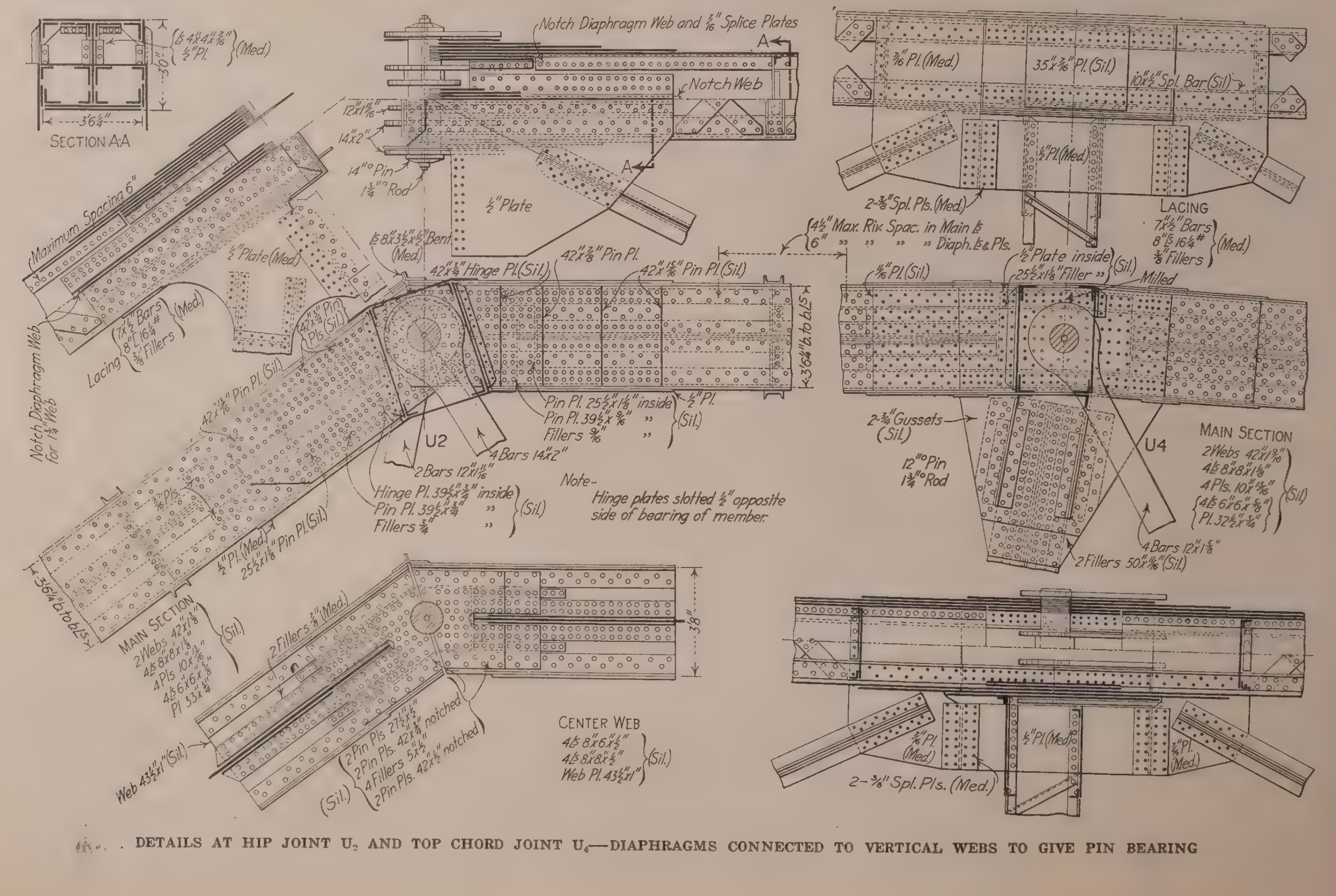
THE 720-ft. record-breaking span of the Metropolis Bridge, one of a series designed to carry the Paducah & Illinois Railroad, a separate company constituting the connecting link between Metropolis, Ill., and Paducah, Ky., for the Chicago, Burlington & Quincy Railroad and the Nashville, Chattanooga & St. Louis Railway, was swung on Dec. 11. The bridge, which was described in the Engineering Record of July 10, 1915, page 53, is more than a mile long and is designed for unusually heavy live loading—Cooper's E-90 engines followed by 7500 lb. per foot of track, with an impact factor which is independent of the loaded length.

The long span is the first through span on the Kentucky side. The trusses of this span are spaced 37 ft. apart on centers, and the design contemplates double-track operation, although only a single track is to be provided at this time. While many of the details and much of the design of this 720-ft. span of the Metropolis Bridge conform to the usual practice and are not unusual, except in size, the details of the hip joint and the method of introducing camber to eliminate secondary stresses in the truss members are of special interest. The rocker end support used in this longest simple span, which exceeds the present record-holding span of the St. Louis Municipal Bridge by 52 ft., is also of particular interest at this time.

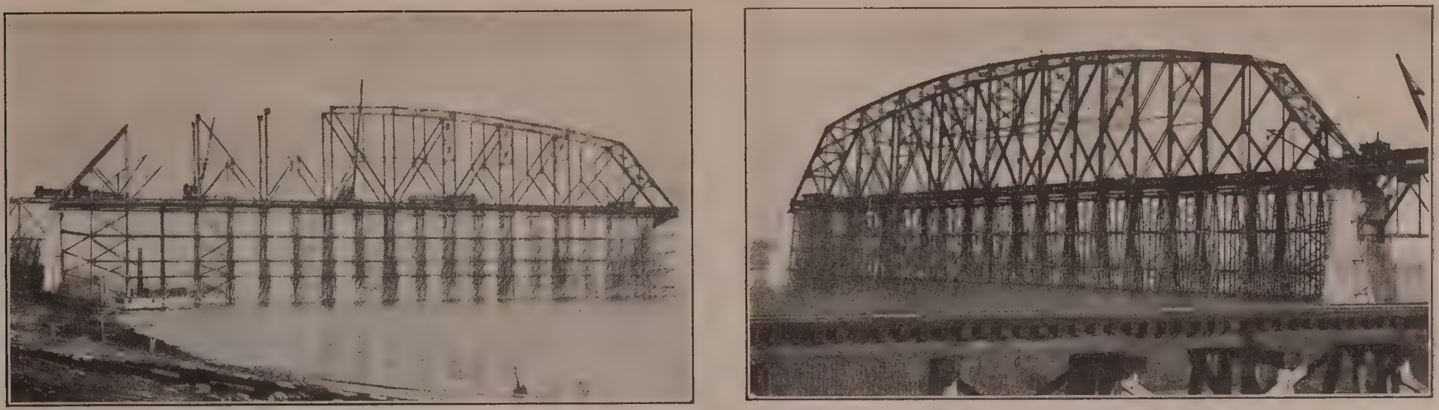
The main chords, end posts, end lower chords and built-up diagonals in the center panels are of silicon steel, the eyebars and pins are of nickel steel and the bracing is of medium carbon steel. As indicated by the accompanying details of the hip joint U_2 and top-chord joint U_4, the main-chord members and some of the posts are built-up H-sections with longitudinal center diaphragms, laced top and bottom by flats and transverse channels. Eyebars 14 in. wide are used for the diagonals in the two end panels and 12 in. wide for the hanger verticals U_2L_2. The lower cord bars are 14 and 16 in. wide, and eyebars are used for the hangers at the subpanel points. The heaviest eyebars are 16 x 1 15-16 in. in the lower chords L_4L_6, with 14-in. pins. The lower chords L_0L_2 are of built-up sections consisting of four webs 39 x 1 in. and eight angles 8 x 6 x 7/8 in.

On an accompanying drawing are indicated the details of the pin plates and the lateral and portal connections at the hip joint U_2. In order to transfer the chord stresses from the center diaphragms to the 14-in. pin, these diaphragm web plates were notched around the center vertical webs bearing on the pin, with four 8 x 8 x ½-in. angles connecting the webs together. Notching of the diaphragm webs and splice plates to clear pin plates was also necessary. The gusset or tie plates on the bottom flanges near the end of the end posts and top chord U_2U_4 are notched, as shown, to clear the eyebar verticals U_2L_2 and diagonals U_2L_4.

The high secondary stresses due to bending of the main members of this subdivided



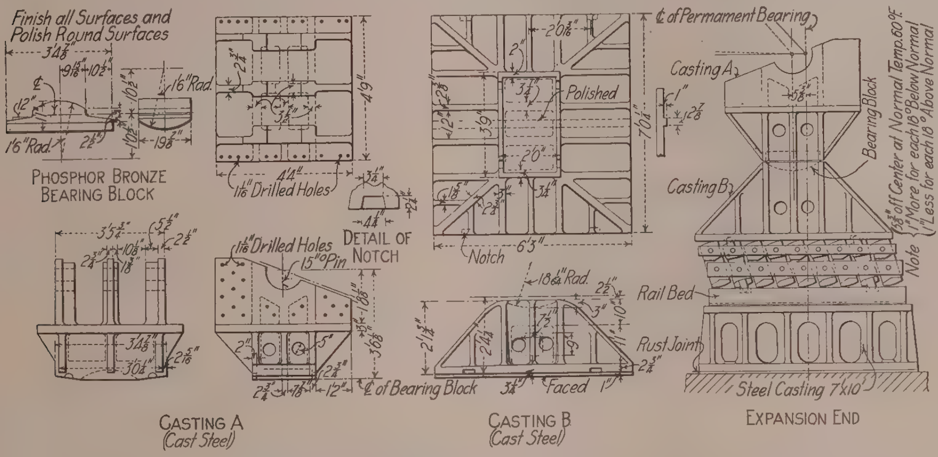
DETAILS AT HIP JOINT U_2 AND TOP CHORD JOINT U_4—DIAPHRAGMS CONNECTED TO VERTICAL WEBS TO GIVE PIN BEARING



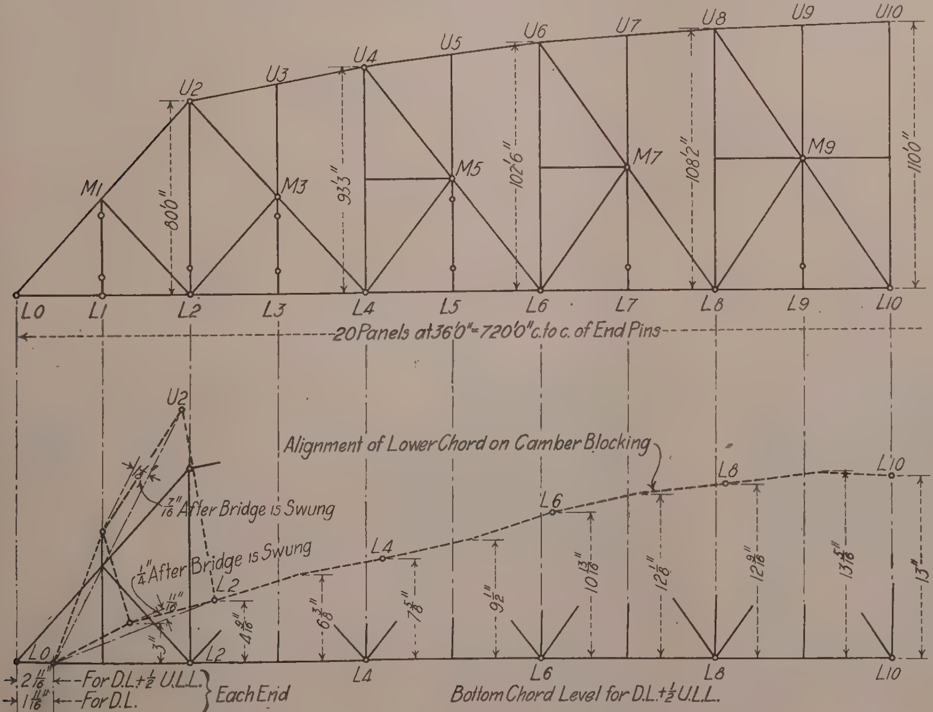
ERECTION OF 720-FT. SPAN BEGAN AUG. 26—PHOTOGRAPHS TAKEN NOV. 25 AND DEC. 11, AFTER BRIDGE WAS SWUNG

panel type of truss, especially in the end posts, are decreased by proper allowance made in locating the erection positions of the lower chord panel points on the falsework. The strains in the subtruss members, and the amount by which the end posts and diagonals must be bent out of line in order to assume a straight position under the prescribed camber loading of dead load plus one-half uniform live load, have been computed. The accompanying camber diagram shows the resulting positions necessary to insure a horizontal lower chord and straight diagonals under the camber loading mentioned. The shop length of all members was of course computed upon this basis.

It is seen that the end posts will be erected 1⅛ in. out of alignment at M_1 and are given a reverse bend in the field after the splice above M_1 is made secure. The chord splices are to be made by bringing the sections to firm bearing and true alignment, held in position by jacks or otherwise, then drilling the holes for the splice and boring the pinhole.



CASTINGS AND PHOSPHOR-BRONZE BEARING BLOCK ALLOW ROTATION IN TWO PLANES


U2
U3
U4
U5
U6
U7
U8
U9
U10
M1
M3
M5
M7
M9
80'0"
93'3"
102'6"
108'2"
110'0"
L0
L1
L2
L3
L4
L5
L6
L7
L8
L9
L10
20 Panels at 36'0" = 720'0" c. to c. of End Pins
Alignment of Lower Chord on Camber Blocking
7/16" After Bridge is Swung
1/4" After Bridge is Swung
2 11/16" For D.L. + ½ U.L.L.
1 11/16" For D.L.
Each End
Bottom Chord Level for D.L. + ½ U.L.L.

CAMBER DIAGRAM SHOWS HOW SECONDARY STRESSES ARE REDUCED

ERECTION ON ROCKER JOINT

In order to provide for the relatively large movements due to the camber and possible lateral displacements during erection, a special end detail has been designed. An accompanying drawing indicates the steel castings and phosphor-bronze bearing blocks which will be used to allow rotation of the end joints L_0 either in a longitudinal or a transverse plane. It is seen that instead of a double-pin rocker casting, a bearing block with perpendicular cylindrical bearing surfaces has been adopted.

Exactness in the placing of the steel on the falsework has been given careful consideration. It is seen that for a normal temperature of 60 deg. the end pin L_0 is to be set 5⅜ in. off the center of the permanent bearing at the expansion end, varied proportionally at the rate of 1 in. for each 18-deg. change in temperature above or below normal.

This bridge was designed by the late C. H. Cartlidge, bridge engineer of the Chicago, Burlington & Quincy Railroad, with Ralph Modjeski, consulting engineer, of Chicago, supervising the design and details, which were worked up in the office of the railroad company. After Mr. Cartlidge's death Mr. Modjeski was placed in charge of the entire construction. The substructure is being built by the Union Bridge & Construction Company of Kansas City, and the superstructure is being fabricated and erected by the American Bridge Company.

Washington Will Spend $5,000,000 on Roads During Next Two Years

More than $5,000,000 will be spent on Washington roads during the next two years, is the estimate recently made by the highway commissioners of that state. The funds to be expended include $2,000,000 of the public highway fund, to be raised by the one-mill levy; the $3,000,000 permanent highway fund, raised by the mill-and-a-half levy; about $430,000 federal-aid money, to be spent by the state, and $91,739 which represents Washington's share of the proceeds from national forests, which are devoted annually to building of roads. The $3,000,000 which it is estimated will be realized on the mill-and-a-half levy will be spent by the counties under the supervision of the state department. The annual appropriation from the forest-reserve money will be expended by the federal government on recommendation of the state highway department.

Reinforced-Gypsum T-Beams for Roof Decks Cast at Site and Hoisted to Place

Steel Purlins Eliminated in Sawtooth Roof by Using 10-Foot Spans—Units Molded in 15 Minutes for Rapid and Economical Construction

By WHARTON CLAY
Architectural Engineer, United States Gypsum Company, Chicago

EVIDENCE that the recently developed material for roof-deck construction, reinforced gypsum, tests of which were described by Mr. Marani in the Engineering Record of Dec. 16, page 745, is both practicable and economical is presented in the application to 10-ft. spans in a sawtooth roof of the building constructed for the Walker Manufacturing Company, at Racine, Wis. At this plant rapid and economical construction resulted from the use of "Structolite," a quick-setting gypsum, for T-beams cast in a molding yard near the building and removed from the molds in about 15 minutes ready for hoisting to the roof in about 4 hours. This is the first time that gypsum has been reinforced and used like concrete for a span as long as 10 ft. This type of construction eliminates the steel purlins, as the gypsum beams span from truss to truss.

Development of Gypsum Tile

The first application of reinforced gypsum was the development of factory-cast solid reinforced roof tile 30 in. long and 3 in. thick, weighing only 13 lb. per square foot, which are set on the roof between steel tees. To decrease the cost of the steel framing, tile from 4 to 6 ft. long were developed, which span from purlin to purlin to eliminate the tees. The light weight of these tile, also only 13 to 14 lb. per square foot, was maintained by increasing the effective depth, using a slab and joist construction.

In order further to decrease the structural steel cost, the development of a tile which spanned from truss to truss, eliminating the purlins, was the next logical step. However, the great length of such tile made factory-cast units impracticable because of the possibility of fracture in shipment. Therefore the longer units are cast at the building site. As the time of set of gypsum can be controlled in the manufacture by the use of retarder, any desired speed of fabrication can be attained and the number of molds reduced to a minimum, depending on the skill and number of the workmen employed.

The process of casting these structural gypsum units is well illustrated by the methods adopted at the Walker Manufacturing Company plant. This building covers an area 180 x 200 ft. and is of sawtooth-roof design, with columns spaced on 20-ft. centers in both directions. A jack truss midway between columns reduces the roof-tile span to 10 ft. between trusses. The dimensions and design of the T-beam reinforced-gypsum units were given in the article by Mr. Marani previously mentioned; they are a standard type similar to reinforced-concrete T-beams. After placing they are covered with a composition roofing.

HOISTING DECK UNITS—INTERIOR VIEW

The light weight of this roof deck, 17 lb. per square foot, made it possible to use minimum sections for the structural frame. The total weight of the steel per square foot of floor area is 5.5 lb., which is low for this type of construction.

Collapsible wooden molds were built just outside the building line at the freight siding and near industrial tracks which enter the building. It was found by experiment that only thirteen molds were required for the most economical operation. The first shipments of gypsum were manufactured with sufficient retarder to allow the workmen ample time to learn their respective duties. Successive shipments were retarded less and less until this small and inexpensive plant increased its output from 600 sq. ft. to 2800 sq. ft. per day. At this speed the gypsum was mixed, cast and removed from the forms in a completely set condition in only 15 minutes and was ready to be hoisted in place in 4 hours.

The maximum day's run was 3120 sq. ft. and the total time required from start to finish of job, manufacturing and laying in place 32,000 sq. ft. of roof, was only 16 working days, making an average of 2000 sq. ft. per day, including the time taken in breaking-in the gang.

Details of Operations in Casting Units

Each man had his specific job and followed the man before him in a regular path from mold to mold. No opportunity for improper proportions was possible in this work, as the gypsum was packed in bags of exactly the weight required, so that two bags made a tile.

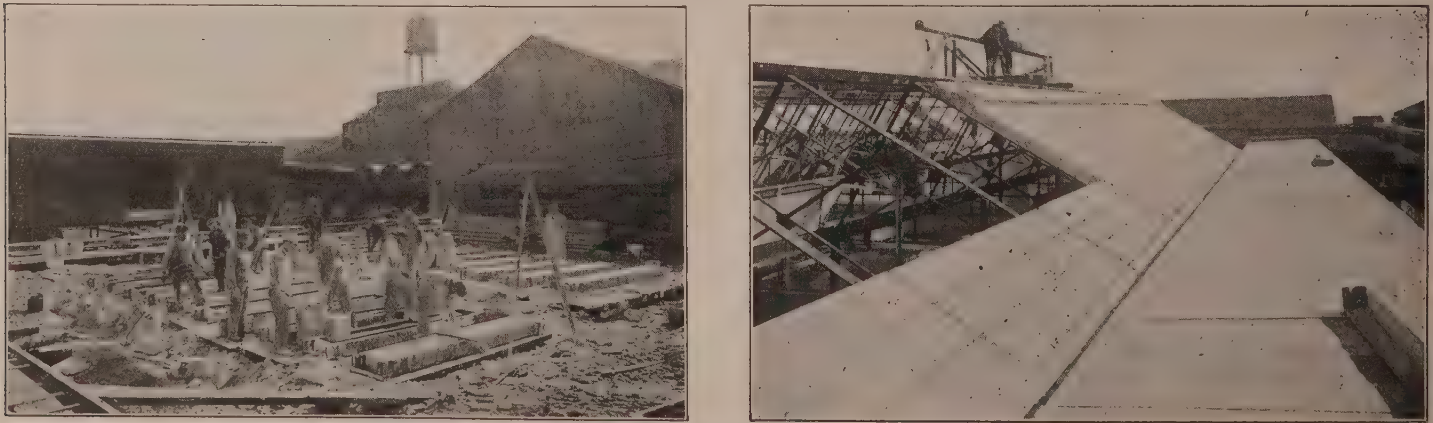
The routine followed in casting the T-beam units was as follows: One man oiled the mold with paraffin and placed the reinforcement on ¾ x ¾ x 2½-in. gypsum chairs set in the bottom at the quarter points; two men carried the sacks of gypsum from the car on an adjacent siding, leaving one sack untied at each end of a mold; one man carried water and filled the measuring buckets at each end of the mold; two molders and two helpers poured the gypsum into the measured water in the mixing buckets, agitating the mixture and pouring it into the mold at the ends. One man adjusted the reinforcement, placed the wire mat in the flange and struck off the top even with the mold.

Wrecking Forms

Three form wreckers followed about 10 to 15 minutes later taking down the collapsible sides of the forms, cleaning and reassembling them. The tile, now firmly set, was carried by two men to a transfer car at one side of the molding yard, pushed into the building and unloaded in position below its location.

The triangular end walls of the sawtooth section, 3 in. thick, were poured on the flat portion of the roof in adjacent bays as monoliths, and then raised into position as complete units.

As reinforced gypsum is designed to be of sufficient strength for its full load when wet, operations may continue during any


GYPSUM BEAMS ARE CARRIED TO ROOF ABOUT 4 HOURS AFTER LEAVING CAR—CASTING YARD ON LEFT

weather conditions when men will work. Tile last molded at night were hoisted the next morning, even though exposed to rain all night. Enough heat is generated in the setting of the gypsum to keep the material warm and prevent damage from freezing temperature.

Concrete of 24 hours' setting time on this job would have required much more labor and 154 molds instead of 13 to finish the roof in 16 working days. Although free sand and free gravel were available on the site for concrete aggregate, the saving in steel due to the lightness of structural gypsum and the saving in labor and in the cost of forms made the gypsum roof cheaper in place than a concrete roof.

The plant of the Walker Manufacturing Company was designed and built by the Arnold Company, Chicago, under the direct supervision of P. L. Battey, vice-president and chief engineer. The detail design of the roof tile was made by Calev Payne of the United States Gypsum Company. This company has been developing gypsum for structural purposes for several years, and made the special tests for the constructors and owners, as quoted in the article by Mr. Marani in last week's issue.

Topographic Maps Made of 1,237,520 Square Miles

This Is 40.9 Per Cent of the United States—1302 Stream-Gaging Stations in 39 States, Alaska and Hawaii

IN THE ANNUAL report of the Secretary of the Interior for the fiscal year ended June 30, 1916, made public Dec. 7, Franklin K. Lane discusses the results of surveys and investigations of water resources conducted by the Department of the Interior.

The report states that new areas amounting to 19,230 square miles were mapped topographically, making the total area of the United States surveyed to date 1,237,520 square miles, or 40.9 per cent of the country. Areas aggregating 3486 square miles were resurveyed, making the total area surveyed or resurveyed during the year 22,716 square miles. These surveys were made in twenty-nine states, seventeen of which co-operated in the work. The technical field force numbered 140, and in addition 36 technical field assistants were employed.

At the end of the year 1302 gaging stations for measuring the discharge of streams were being maintained in thirty-nine states, Alaska, and Hawaii. Investigations of underground waters have been made in sixteen states, in Alaska and in Cuba. Investigations of the present and possible use of both surface and underground waters have been made in connection with the classification of public lands, especially with reference to their use for power under government permit or for agriculture under the enlarged-homestead, desert land, or Carey acts. In the hydrographic work three states and Hawaii cooperated, as well as the Reclamation Service, Forest Service, Indian Office, Engineer Office, Navy Department, War Department, Department of Justice and the city of San Francisco, largely in the study of the flow of certain streams. About 64 per cent of the appropriation of $150,000 was spent on the public-land states, largely in stream gaging. The technical force engaged in the work on water resources numbered seventy.

Literature

For the Civil Engineer and Contractor

New Publications

List of References on Valuation of Steam Railways. Prepared by the Bureau of Railway Economics, Washington, D. C. Bulletin 190, American Railway Engineering Association. Paper, 6 x 9 in.; 154 pages. Chicago, American Railway Engineering Association.

This list of references is limited strictly to the economic aspects of the valuation of steam railways, all but the more striking literature relating to other public utilities being excluded.

Handbook of Formulas and Tables for Engineers. Compiled by Clarence A. Peirce, assistant professor of power engineering, Cornell University. Mathematical sections by Walter B. Carver, assistant professor of mathematics, Cornell University. Second edition, revised and enlarged. Flexible leather, 4 x 6¾ in.; 188 pages; illustrated. New York, McGraw-Hill Book Company, Inc. $1.50 net.

This second edition of this useful little handbook contains a few corrections of errors in the first edition and a small amount of new material—including formulas of hydraulics, tables of natural logarithms and hyperbolic functions. Requests for further additions were denied because of the restriction to convenient pocket size.

Community Action Through Surveys. By Shelby M. Harrison, director, department of surveys and exhibits, Russell Sage Foundation. Paper, 6 x 9 in.; 29 pages. New York, Russell Sage Foundation, 130 East Twenty-second Street. 10 cents.

This paper was presented in part at the Indianapolis meeting of the National Conference of Charities and Correction in May, 1916.

Citizen Agencies for Research in Government, Part 1. Bulletin 77, Bureau of Municipal Research. Paper, 6 x 9 in.; 114 pages. New York, Bureau of Municipal Research, 261 Broadway. $1.

Geology and Ground Waters of Northeastern Arkansas. Water-Supply Paper 399, U. S. Geological Survey. Paper, 6 x 9 in.; 310 pages; illustrated. Washington, Government Printing Office.

Bridge Manual for County Superintendents of Highways, Resident Engineers and Inspectors. Bulletin 10, Illinois State Highway Department. Prepared by Clifford Older, bridge engineer. Paper, 6 x 9 in.; 104 pages; illustrated. Springfield, Ill., State Highway Department.

The Flow of Water in Wood-Stave Pipe. By Fred C. Scobey, irrigation engineer, with discussion by others. Bulletin 376, U. S. Office of Public Roads and Rural Engineering. Paper, 6 x 9 in.; 96 pages; illustrated. Washington, Government Printing Office.

Tabulated Data Relating to Flow of Water Under Pressure Through Clean Closed Pipes. By George T. Prince, C. E. Flexible leather, 4½ x 6½ in.; 149 pages; illustrated. New York, D. Van Nostrand Company. $2 net.

The Administration of Industrial Enterprises. By Edward D. Jones. Cloth, 5 x 7½ in.; 442 pages, illustrated. New York and London, Longmans, Green & Company. $2 net.

Department of Wharves, Docks and Ferries, Philadelphia: Annual Report, 1915. Paper, 6 x 9 in.; 145 pages; illustrated. Philadelphia, George S. Webster, Director, Bourse Building.

Sewage Disposal for School Buildings in Ohio. By R. S. Durrel and D. E. Adams, assistant engineers, division of sanitary engineering, Ohio State Board of Health. Paper, 6 x 9 in.; 13 pages; illustrated.

Reprint from the Ohio Public Health Journal, August, 1916.

Canadian Trade Index. Cloth, 7 x 10 in., 560 pages. Toronto, Canada, Canadian Manufacturers' Association. $5 net.

Standardization of Public Employments, Part 2. Practical Side of Standardization in American Governments. Bulletin 76, Bureau of Municipal Research. Paper, 6 x 9 in.; 148 pages. New York, Bureau of Municipal Research, 261 Broadway.

Treatise on Hydraulics. By Mansfield Merriam. Tenth edition, revised with the assistance of Thaddeus Merriman. Cloth, 6 x 9 in.; 565 pages; illustrated. New York, John Wiley & Sons, Inc.,; London, Chapman & Hall, Ltd. $4 net.

In this latest addition of Merriman's well-known text book, over 40 pages have been rewritten and minor changes made in about 50 other pages. The new articles treat proportional weirs. Biel's formula for flow in pipes and channels, backwater due to bridge piers and hydraulic machinery. The articles on turbines have been revised to include modern turbines.

Mechanical Equipment of Buildings—Volume 1, Heating and Ventilation. By Louis Allen Harding, B. S., M. E., chief engineer and member of firm of John W. Cooper Company, Buffalo, and Arthur Cutts Willard, S. B., assistant professor of heating and ventilation, University of Illinois. Leather, 7 x 9 in.; 615 pages; illustrated. New York, John Wiley & Sons, Inc. $4 net.

This first volume of a new reference work for engineers and architects treats only heating and ventilation systems and details. Subsequent volumes are planned to cover power plants, elevators, lighting systems, refrigeration plants, sprinkler systems, vacuum cleaning and plumbing. The object of the authors is to present sufficient theoretical and commercial data for practical use in the drafting room, and at the same time show students the relation between theoretical principles and practical applications. Extensive use is made of manufacturers' data. The first volume contains 21 chapters, covering the heating and ventilating field from the elementary definitions of heat units and complete theoretical treatment of fundamentals up to the discussion of cost of equipment and the preparation of plans and specifications.

Progress Reports of Experiments in Dust Prevention and Road Preservation, 1915. Bulletin 407, U. S. Department of Agriculture, Office of Public Roads and Rural Engineering. Paper, 6 x 9 in.; 71 pages. Washington, Government Printing Office.

Rules, Regulations, Forms and Practice Relative to the Control, Distribution and Use of the Water Resources of Oregon. Compiled under the direction of John H. Lewis, state engineer, by Percy A. Cupper, assistant state engineer. Paper, 6 x 9 in.; 70 pages; illustrated. Salem, Ore., Bulletin 6, Office of State Engineer.

Water Supply—Considered Principally from a Sanitary Standpoint. By William P. Mason, professor of chemistry, Rensselaer Polytechnic Institute. Fourth edition, rewritten. Cloth, 6 x 9 in., 528 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. $3.75 net.

Weights of Steel. Computed by Thomas J. Elliott. Flexible leather, 6 x 9 in.; 662 pages. Cleveland, Ohio, The Penton Publishing Company. $20 net.

For the use of engineers, architects, contractors, builders and steel manufacturers in the exact computation of weights of rolled shapes for lengths varying from 1/16 in. up to 60 ft. It also includes the weights of round and square rods and deformed reinforcing bars of the usual lengths.

Transactions of the International Engineering Congress 1915; Index Volume. Paper, 6 x 9 in.; 273 pages. San Francisco, W. F. Durand, chairman of committee of management.

Section 1 gives historical and statistical information; section 2 short abstracts of the papers presented, and section 3 is a contents and author index.

Monthly Bulletin, Pennsylvania Department of Labor and Industry, September, 1916. Paper, 6 x 9 in.; 104 pages. Harrisburg, Pa., William Stanley Ray state printer.

A compilation of all essential portions of Pennsylvania labor laws that should be known by all employers, employees, employment agents and proprietors of institutions and public halls throughout this commonwealth.

Books Reviewed

Municipal Engineering Practice

Author, A. Prescott Folwell, past president of the American Society of Municipal Improvements; editor of *Municipal Journal*. Cloth, 6¼ x 9¼ in.; 422 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. $3.50 net.

REVIEWED BY JOHN H. GREGORY

Consulting Engineer and Sanitary Expert, New York City

In this interesting book the author has brought together matter on several branches of municipal engineering not readily obtainable elsewhere. No attempt is made to treat of sewerage, water supply and street paving, the reader being referred to standard text-books for such matters.

The first chapter is devoted to a discussion of certain fundamental data needed by the municipal engineer as a guide in solving many of the problems which fall to his lot to work out. The nine subsequent chapters treat respectively of the city plan; street-surface details; bridges and waterways; city surveying; street lights, signs and numbers; street cleaning and sprinkling; disposing of city wastes; markets, comfort stations and baths, and parks, cemeteries and shade trees.

The author has had an exceptional opportunity for acquiring a vast amount of information on the subjects of which the book treats, and from this material he has selected that which has real value. He has been unusually successful in presenting this material in such a manner as to make the book exceedingly readable. Although the book is non-technical, it contains a great amount of practical data and information which the technical man needs, and while some of the subjects are treated in a more or less general manner, others are gone into in much detail.

The average city engineer, especially in the smaller and medium-sized municipalities, is generally supposed by the layman to be an expert in all branches of municipal engineering, and it is especially to the large number of such engineers, as well as to all engineers who may, at times, be called on to do work of a nature similar to municipal engineering, that the book will appeal. To the young engineer just entering the field of municipal engineering the book should be invaluable. If carefully and conscientiously read he will have brought to his attention many suggestions and ideas which otherwise might be acquired only after many years of active practice. And if city officials, under whose general direction municipal engineering works are carried out, would take the time to read the book they would be well repaid for the time thus spent.

The book is well written, contains numerous carefully chosen illustrations, both drawings and halftones, and is well indexed.

Passenger Terminals and Trains

Author, John A. Droege, general superintendent, New York, New Haven & Hartford Railroad. Cloth, 6 x 9 in.; 410 pages; illustrated. New York, McGraw-Hill Book Company, Inc. $5 net.

Knowing the author to be a railroad operating official, undoubtedly fully cognizant of all that goes to make up a convenient and efficient passenger terminal, and recognizing in "Passenger Terminals and Trains" a pioneer in the field, and a book that is worth its price just for its illustrations of terminals all over the world, the reviewer hesitates to say that the book is disappointing. Perhaps this disappointment is because the author's earlier work, "Freight Terminals and Trains," was so satisfying. The new book, however, seems almost to have been addressed to the public rather than to the technical man. The author does not set forth his views concisely, but describes—in very interesting fashion, it is true—station after station, each one of which, it is found on reading, illustrates one or more features that seem desirable to the author. The track layout is subordinated to a surprising degree to the arrangement of facilities in the building. The architect will find his field wholly covered, but the track man will have to be contented with generalities.

The chapters that directly concern the engineer are mainly in the first part of the book. A chapter on general principles is followed by one on construction and maintenance details. While it may be a little difficult to find the author's views on a specific point, the latter chapter is replete with useful suggestions.

Chapter 3, "Interlocking and Approaches," is one of the disappointments of the book. Written in collaboration with a signal engineer of the New Haven, it features the signaling almost to the exclusion of the track details. Important as the signal system is, the best system in the world could not save a terminal with an ineffective arrangement of ladders, crossovers and approach tracks. The chapter gives little help on this point.

Through stations, head stations, waterfront terminals and the terminals of New York City are the subjects of the next four chapters. These rank with the best in the book, and give the reader 106 pages, abundantly illustrated with both photographs and plans. They, with a Chapter 3 on somewhat different lines, would give both the architect and the track man a comprehensive idea of how to combine in the solution of their problems the best that has been done elsewhere. The track man would still have to go to a subsequent chapter on car-cleaning plants to learn about coach yards, and here, again, he would fail to find useful recommendations of the yards and terminals committee of the American Railway Engineering Association relative to track centers, desirability of stub tracks, and the like.

Three more chapters in the book, on small stations, foreign passenger trains and terminals and electrification, are of direct interest to the engineer. The remaining chapters would appeal to him as a railroad man rather than as an engineer, as some of the titles indicate—"The Station Master," "The Ticket Office," "Train Indicators," "Accidents and Their Prevention," etc. Two of them, "Passenger-Terminal Operation" and "Passenger-Train Operation," suggest that perhaps here will be found mention of the studies of terminal operation made by the yards and terminals committee of the American Railway Engineering Association. There is no such mention. The chapters are written from the viewpoint of how the operating department can satisfy the public with the facilities available, not whether the facilities are of proper capacity or arrangement.

And now, having found considerable fault with the volume, the reviewer would urge all interested in passenger terminals to read it. While the book does not tell all that a terminal designer should know, it tells much and shows much by plan and picture. And it is likely to be some time before the subject is covered better.

Laboratory Manual of Bituminous Materials for Highway Use

Author, Prévost Hubbard, chemical engineer, chief of the Division of Road Material Tests and Research, Office of Public Roads and Rural Engineering, U. S. Department of Agriculture; lecturer in highway engineering chemistry, Columbia University. Cloth, 6¼ x 9¼ in.; 153 pages; illustrated; blank pages for notes. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. $1.50 net.

REVIEWED BY S. WHINERY
Consulting Engineer, New York City

In this little book the author has brought together and systematized the laboratory technique of classifying, analyzing and testing the various bitumens that are now so largely used in paving and highway work. Heretofore most of the literature on the subject has been scattered through books, the proceedings or committee reports of technical societies, and the engineering press, and was not always readily available to the student or engineer.

The reader is likely to be impressed with the idea that the main purpose of the author was the preparation of a suitable textbook for classes in the technical schools, but like all good text-books, it deserves, and is likely to have, a much wider field of usefulness.

The book is not confined strictly to the chemical and physical processes and results of the laboratory; it contains much valuable information on the mineralogy, classification, and physical properties of the bitumens, and their uses in highway building.

One feature of the book is especially worth noting. Following the description of each analysis or test is a concise discussion of its interpretation, value, or significance as related to highway work. After all, this is the important thing to be kept in mind, for the most complete and accurate laboratory work is of little practical value unless we know how to apply it intelligently so as to obtain the best results under varying conditions.

The book is divided into three parts. Part 1 is devoted to types and classification of bituminous materials, the collection and preparation of samples, and forms for recording results. It includes more than five pages of definitions of words and phrases used in connection with highway work, as adopted by or proposed to the technical societies.

Part 2, entitled "Methods of Testing," covers the laboratory work proper and the interpretation or value of the tests. Part 3, on "Characteristics of the More Important Bituminous Materials," is devoted to a brief but comprehensive description of the various bitumens used in highway work and their characteristics.

On the whole, the book covers its field very satisfactorily and is a valuable addition to our literature on highway construction.

American Sewerage Practice: Volume 3—Sewage Disposal

Authors, Leonard Metcalf and Harrison P. Eddy. Second edition, with appendix on activated sludge, and minor revisions. Cloth, 6½ x 9½ in.; 877 pages; illustrated. New York, McGraw-Hill Book Company, Inc.; London, Hill Publishing Company, Ltd. $6 net.

REVIEWED BY GEORGE W. FULLER
Consulting Engineer, New York City

Under date of Aug. 29, 1916, in reprinting this volume, the authors have taken advantage of the opportunity to add an appendix of about twenty-five pages descriptive of the activated-sludge process for the treatment of sewage and other waste liquids. This new matter is a comprehensive, conservative statement of this phase of the subject and will be read with interest by all those who are engaged in the consideration of sewage-disposal problems of magnitude.

Slight revisions where necessary have also been made, as is customary in books of this size and character.

Gage Stations in Oregon Stream

In order to compile more complete records of the flow of Oregon's streams on which to base studies of water-power and irrigation possibilities, gage stations have recently been established on nearly all the important streams in that state not heretofore gaged. Weekly reports of gage readings will be made to the government. The installations were made under the direction of Charles F. Batchelder of the U. S. Geological Survey and V. H. Reineking, consulting engineer, of Portland, who recently completed a 2500-mile trip by automobile, undertaken to establish the stations and employ resident recorders.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Sand Boxes to Lower Arch Centers

SIR: Referring to the article by Frank P. McKibben in your issue of Oct. 28, page 530, Professor McKibben mentions the cast-steel double-screw wedges that were used at the Rocky River arch, Cleveland, and states that the cost is said to have been somewhat in excess of that of sand boxes. If you will refer to the article on "Steel Centering Used in the Construction of the Rocky River Bridge," written by the writer and published in the *Transactions* of the American Society of Civil Engineers, Vol. 74, page 9, you will find the estimated cost of sand boxes, screw wedges, screw jacks and hydraulic jacks for this work.

The screw wedges cost $350 more than the sand boxes and saved more than this amount to the contractor, due to the fact that they were designed to lift the dead load of the centering as well as to lower the centering when the load of the arches was on. These double-acting screw wedges were very successful and enabled the centers to be removed and jacked up into their new position in a remarkably short time, and it is the writer's opinion that they proved themselves to be far superior to sand boxes for this purpose. These wedges were purchased by the McClintic-Marshall Construction Company after they were used at the Rocky River bridge, and it is our understanding that some of them were used at Panama in the erection of the lock gates for the canal.

WILBUR J. WATSON,
Chief Engineer, Wilbur J. Watson & Company.
Cleveland.

[The following estimated costs of the different types of lowering devices are given in the article to which Mr. Watson refers: Sand boxes, $1,300; screw wedges, $1,650; screw jacks, $2,000, and hydraulic jacks, $2,400.—EDITOR.]

Why Not Grout Cracks of Old Brick Pavements?

SIR: Much has been written recently about monolithic brick pavements and improved methods of grouting, but I have failed to see anything about cleaning out the cracks of old pavements and refilling them with grout. Many miles of brick pavements are in very fair shape so far as the general contour and surface are concerned, but the edges of the joints have spalled off and the filler has been replaced by dirt. Why cannot these cracks be cleaned out and the pavement grouted to make it smooth and sanitary, to say nothing of materially prolonging its life?

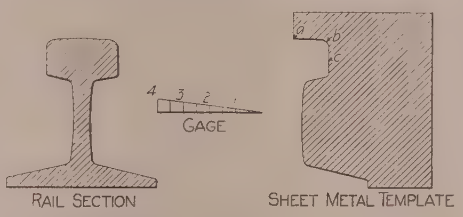
A simple way of removing the dirt is essential; the grouting process is sufficiently standardized not to need any discussion. It is suggested that a comparatively small boiler could be mounted on a truck to furnish steam through a hose and nozzle under high pressure for the purpose of loosening up the dirt in cleaning the joint clear to the bottom. It would probably be advantageous to flush the street of any surface material to start with so as to moisten the dirt to the bottom of the joints. Water from the street hydrants might be used to do the work, if it was found not to disturb the sand cushion with which practically all former pavements of brick were laid. There would be hardly enough moisture from the condensed steam to do any damage.

INTER NOS.

[Undoubtedly some one has tried out the grouting of old brick pavements as suggested, although it is doubtful if any one has used steam to clean out the joints. A discussion of this addition to the maintenance engineer's remedies is solicited.—EDITOR.]

Gage to Measure Rail Wear

SIR: The article in the Engineering Record of Nov. 4, page 555, describing a gage for measuring wear on rails, brings to the writer's mind a device used by him in 1906 as tapeman with the Chicago & North Western Railway, at Omaha. The apparatus consisted of a template of sheet metal, made to fit the standard section of rail to be measured, and a triangular gage of the same material graduated as shown in the drawing.



TEMPLATE FOR STANDARD RAIL SECTION

The work was done by two men, one keeping the notes and the other manipulating the tools. The template was held against the base and web of the rail, the gage inserted at the points *a*, *b*, *c*, or at others if desired, and the amount of wear recorded as read on the gage.

The foregoing statements are from memory, but are believed to be essentially correct.

C. H. EIFFERT.
Dayton, Ohio.

How Shall He Melt Lead from Joints of Water Line?

SIR: What, in your judgment, is the best way to melt lead from joints of an abandoned 24-in. cast-iron water line? I may become interested in taking up 16,000 ft.

I was thinking of uncovering the pipe with a dragline, spading by hand below the spring line, melting out the lead two-thirds of the way around from the top side down, using a gasoline blow torch or a carbide outfit, pulling the pipe and hoisting it to the bank with the dragline.

If you are able to give me any ideas along lines that will help I will appreciate it. The job is large enough to afford spending a few dollars in equipment.

Houston, Tex. HARRY WATTS.

[Perhaps some of the readers of the Engineering Record can suggest a good method of doing the work.—EDITOR.]

New Methods Devised for Building Ships of Concrete

SIR: In a recent issue of the Engineering Record I noticed an article regarding Norwegian concrete barges and a short comment by a naval engineer, who stated that although numerous barges of this kind had been built in this country and the Panama Canal Zone, their use had not been an unqualified success and that the possible advantages in cost would be more than counteracted by increased cost of propulsion due to the heavier weight of the vessel.

There is, without question, a great future for reinforced concrete in ship construction. The first attempts have necessarily been crude and have therefore not always been entirely successful. However, we must not forget that all great inventions, especially in ship construction, have been the results of scientific development of ideas which often were introduced by laymen in a very crude form, and were later, with the assistance of experienced marine engineers, transformed into the great successes of the present day. Compare the steamship of to-day with the first vessels of this kind. Consider the difficulties which had to be overcome in introducing iron and steel in ship construction and you will probably agree that the concrete ship of the future will undergo the same development change of opinion, and of course will also be a great success after the combined experiences of the marine and the concrete engineer have come to its assistance.

I have made the building of concrete ships one of my life's problems, and have carefully studied the scientific principles which must be adopted in order to insure success. Not only for the construction of smaller vessels, as barges and scows, is concrete an entirely suitable material, but also for large ocean-going ships will its use be perfectly safe and extremely advantageous.

The principal faults of all previous attempts at concrete-ship construction have been that concrete builders tried to use everyday methods and means in design and mixing and applying the materials. Most of these vessels were built of ordinary concrete mixed and placed in the common way. The special requirements of ultimate service were not sufficiently taken into consideration. The designs were made without consultation with marine engineers, and the strains which the empty and the loaded ship had to resist under all the different and changing conditions were only more or less intelligently guessed at.

In spite of all this, however, satisfactory results have been obtained in most cases, and therefore the subject is worthy of careful consideration and encouragement, especially at this time when the production of freight ships is one of the greatest problems of all nations.

So far two methods have been used for the construction of concrete barges:

The first method consisted in building an inside and outside form for the ship's hull, and between these forms (which were separated to allow for intended wall thickness) the necessary reinforcement was placed. Then a concrete, composed of Portland cement, sand and crushed stone or gravel, was poured in a semi-liquid condition to fill the forms and to incase the steel reinforcement. After the concrete had sufficiently hardened, the forms were removed and the barge was finished by pouring bulkheads, division walls, decks, etc., in a similar manner.

This method resulted in extremely clumsy and heavy vessels, which can only be used for sand and construction barges. The ship itself is unelastic, and in collision with wharfs and other vessels dangerous cracks develop which are difficult to repair and which will often result in loss of the entire ship.

The second method consists in using a light steel skeleton, placing over the outside of it an expanded metal or wire fabric and finishing the hull by plastering over this sheathing a rich mortar coating in the same manner as light curtain and partition walls are formed in fireproof-building construction. This method is a great improvement over the first one, but can only be used for smaller boats, launches, etc., and of course is practically out of the question for freight barges.

I have invented and developed a series of entirely new methods of construction which not only solve the problem in a scientifically correct manner, but allow the building of large and small concrete vessels of remarkable elasticity and of comparatively light weight. In addition to this, the cost of construction is greatly reduced because no forms are required. All concrete is handled, applied and finished by machinery especially designed by me for this purpose. The risk of poor workmanship is almost completely eliminated.

Owing to the present international patent situation, I am not able to publish complete details of construction. In order, however, to give some advance information to your readers who are interested in the subject I will here explain the general outlines of the methods employed in my systems:

The ship's hull consists of a strong framework of steel, which is so designed that the combined strength and advantages of steel and concrete are fully recognized. This truss frame is erected and riveted in the ordinary manner. In the completed ship the steel frame is entirely incased in concrete and thereby protected against rusting. By this incasing the steel members are also stiffened and the buckling stresses are greatly reduced. For this reason the steel members of the frame are of simple design and relatively light weight.

After the steel frame is completed it is covered with my multiple-unit wall construction of varying thickness. The walls are formed of a high-grade concrete applied by compressed air, and each section is independently reinforced by networks of light steel bars and wire mesh. All ship walls, bulkheads, decks and partitions are formed in a similar manner without the presence of any construction or connection joints, so that the completed ship is one seamless, monolithic structure.

The concrete is composed of Portland cement and crushed quartz or other suitable stone material. All pieces not passing a ½-in. screen are rejected. These materials, with the necessary waterproofing medium and the water for proper hydration, are mixed and ground together, and before being placed are properly conditioned to reduce the danger of cracking because of excessive expansion and contraction.

The material so prepared is applied in even and uniform layers by means of a powerful stream of compressed air with a special machine named the "Tector," especially designed by me for this purpose. For the material combination thus described the name "Torcrete" has been adopted. It is really a waterproof concrete of highest possible quality.

After the last coat of Torcrete has sufficiently hardened, the outer surfaces are rubbed down to an even, smooth finish with rotary compressed-air-driven grinders, and the entire ship may be painted as usual.

These, of course, are only the general outlines of future cement, or rather Torcrete, ship construction. These methods can also be advantageously employed for reconstruction and repair of old steel ships and for placing of bulkheads, tanks and decks in old hulls.

The principal advantages of the Torcrete ship are its low cost and the rapidity with which such vessels can be built. However, even at a considerably higher price, its use would be of greatest value for cargoes which require even temperatures and which are destructive to steel. For tank barges, ore and coal boats, refrigerator ships and similar vessels, the advantages of a nonrusting ship will be quickly recognized. Improvements will be made as quickly as the development suggests, and of course the combined experiences and efforts of marine, concrete and structural engineers must be utilized to the fullest extent.

Carl Weber,
President, Cement-Gun Construction Company.
Chicago.

Longest Span Slab Used in Chicago Hospital

Sir: It is to be regretted that J. Norman Jensen did not give more data in regard to the 36-ft. 15-in. tile hospital floor described and illustrated in the Engineering Record of Aug. 19, page 233, and show where it does or does not meet the requirements of the Chicago building code. In this code we note that 1:2:4 concrete is limited to 700 lb. extreme fiber stress, also that the clear space for concrete below steel must equal the diameter of bar, which, in this case, would place the center of steel 1½ in. from the bottom and 16½ in. from the top.

Making use of the portion of the web of beam below the flange as being more favorable than the use of the flange alone, we find the neutral axis to be 6.08 in. below the top and the effective depth to be 14.47 in. The weight of this floor, including 6 lb. for the plastered ceiling below, and steel is about 128 lb. per square foot, which with 50 lb. for the live load gives a total load of 178 lb. per square foot. As no reinforcement is shown in the top at the ends, this beam must be considered as discontinuous, and $wl^2/8$ must apply. The resulting moment at the center is 489,900 in.-lb.

The extreme fiber of the concrete is stressed to 806 lb. per square inch. This is 15 per cent above the allowable code value of 700 lb. per square inch.

A great many architects and some engineers seem to think partitions have no weight, and these are neglected in their calculations. In the article referred to the statement is made that with this design the partitions can at any time be shifted to whatever position any new arrangement of rooms may dictate. Now, assuming an 8-ft. corridor and a 12-ft. ceiling and light partitions of, say, 3-in. "Pyrobar" weighing 16 lb. per square foot, we obtain a moment in the beam of 46,700 in.-lb., and for the partition between the rooms a moment of 225,800 in.-lb. if taken by one beam, or 112,900 in.-lb. if divided between two beams, or 75,260 in.-lb. if distributed over three beams. Taking the latter supposition, we have 489,900 + 46,700 + 75,260 = 611,860 in.-lb., producing a stress in the extreme fiber of the concrete of 1000 lb. per square inch, which would require 2.35 sq. in. of steel reinforcement in the bottom, against 2 sq. in. shown. If a reinforced-concrete floor or other structure after being "skinned" will pass the building departments simply upon test, why not make the test method apply to steel construction as well?

Charles F. Serviss,
The Walter P. Rice Engineering Company.
Cleveland.

[The foregoing letter was submitted to Mr. Jensen, and his reply follows.—Editor.]

Sir: In reply to the communication of C. F. Serviss, I beg to advise that the design in question met with the approval of the engineers of the Building Department of Chicago, and the test was also satisfactory to this department. As Mr. Serviss did not clearly show how he obtained the results he did, it was impossible to check his figures.

In regard to the sweeping denunciation of architects, I wish to state that this design was prepared by a firm of architects whose fame in certain lines of building construction is national. It seems almost a waste of energy to discuss and attempt to prove the weakness of a piece of construction which was carrying, without any evidence of failure, a load five times the live load for which it was designed.

J. Norman Jensen,
Chicago. Architectural Engineer.

To Compute Properties of Unsymmetrical Sections

Sir: The article in your issue of Dec. 2, page 682, entitled "To Compute Properties of Unsymmetrical Sections," is another illustration of the saying, "There is nothing new under the sun," as the identical method illustrated was shown in the first edition of "Osborn's Tables," published in 1886, thirty years ago.

Frank C. Osborn,
Consulting Engineer.
Cleveland.

Sir: I noticed in your issue of Dec. 2 an article on page 682 giving a method of computing moment of inertia of box sections. This identical method is one which I have used for a number of years and which I presented in my book on plate-girder design, which was published in 1913 by the McGraw-Hill Book Company, Inc.

Lewis E. Moore,
Bridge and Signal Engineer, Massachusetts Public Service Corporation.
Boston.

[It was realized, when published, that this was an old method; however, for the benefit of the many students and engineers found to be using the longer methods, it was decided to present it.—Editor.]

Colorado Town Cannot Prohibit Pavement Use by Ordinance

Fort Collins, Col., tried to prohibit by ordinance the use of its new paved district by wagons hauling beet pulp, but it has had to repeal the ordinance to comply with injunction orders of the district court.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*

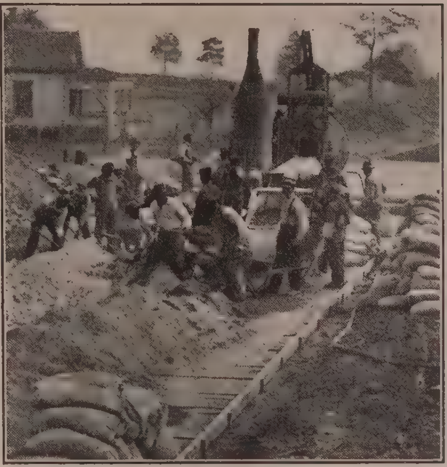
Full-Width Iron-Shod Screed Gives Crown to Concrete Road

By J. M. OATES, Jr.

Superintendent, Pittman Construction Company, Atlanta, Ga.

IN ORDER to give the required curved crown to an 18-ft. concrete road, a full-width screed shod with No. 12 gage iron has been found to be rapid and satisfactory. This screed, illustrated in one of the photographs, is built up of two ⅞-in. boards 8 in. wide at the ends and 20 ft. long, trimmed on the lower edges to the desired curved outline for the road surface to a crown of 2 in. in 18 ft., making them 6 in. wide at the center. The boards are fastened with screws to 2 x 4-in. blocks spaced about 2 ft. 3 in. apart, and shod on the bottom with No. 12 gage iron 8 in. wide, turned up 1 in. on each side and screwed to the boards on side and bottom and to the separating blocks, using countersunk screws on the bottom.

Two handles at each end are made of bent ¾-in. round iron and a ¾-in. pipe 6 in. long, fastened through end blocks by ½-in. bolts 7 in. long. To give weight to the screed, the trough between the boards may be filled with stone or earth. In operation, the screed is handled by one man at each end and supported by the 2 x 4-in. timber form boards on the sides, being pushed back and forth to bring the concrete down to the exact level. A long-handled roller is then run over the surface, which is finished by dragging with a ¾-in. hose.

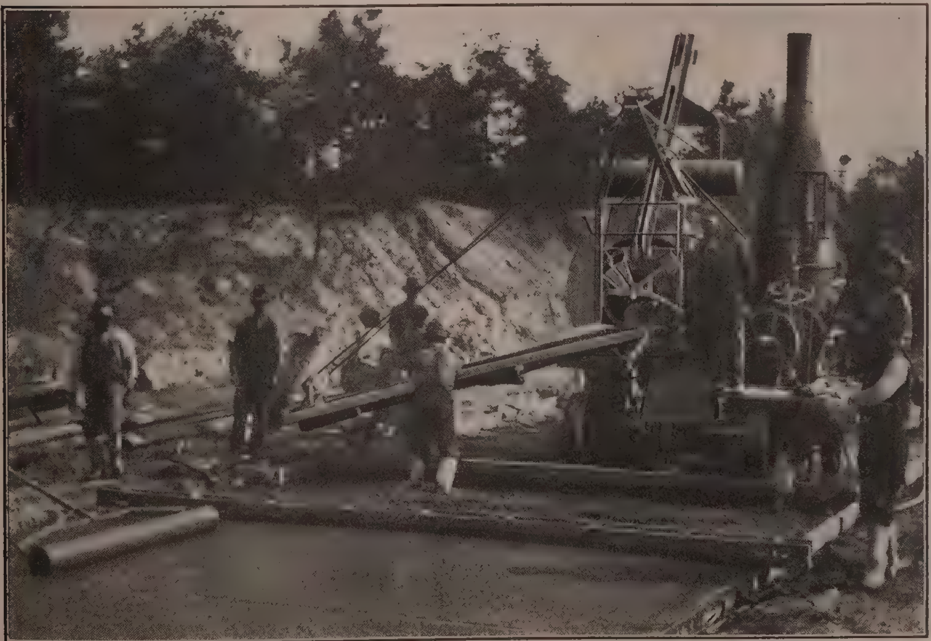


CONCRETE ROAD MATERIALS DELIVERED ON PLANKING PRESERVE SUBGRADE

The concrete aggregates were delivered on a plank roadway placed on the completed subgrade for a distance of 1000 ft. This distance was just sufficient to store enough material for two days' run of the mixer. For this roadway 2 x 8-in. pine boards 16 ft. long were used.

Another special feature of this concrete road work is the use of a simple expansion joint detail. These joints are located every 25 ft. by placing a ⅞-in. board supported by six ⅞-in. round iron pins 16 in. long hooked over the top and driven 8 in. into the subgrade. Tar paper is laid against this board, with the top edge 2 in. below the top of the board, to which it is held by 1½ x ⅛-in. iron staples 9 in. long. Thus when the concrete is placed no evidence of the joint appears at the surface, but the contraction occurring in winter weather causes cracking at the plane of weakness above the tar-paper joint.

The road here described is called the Mason and Turner Ferry road, located a few miles outside of Atlanta, Ga. It is 2.25 miles long and connects with the Hightower road, which is 1.7 miles long and of similar construction. Both roads are being built, under the supervision of the writer, by the Pittman Construction Company, of Atlanta.



FULL-WIDTH SCREED LEVELS AND CROWNS CONCRETE ROAD—ROLLER FOLLOWS

Temporary Studs Aid in Spacing Steel for Circular Reservoir

By D. H. MATHIAS

Circular Concrete Company, Minneapolis, Minn.

VERTICAL 2 x 4s in which 20d. spikes were driven at proper intervals were used recently to support in exact position the horizontal steel reinforcing for a small circular concrete reservoir, constructed by the writer's firm, until this steel could be wired securely to the vertical reinforcing rods. The proper placing of the horizontal steel in reinforced-concrete tanks and bins of the circular type is of the first importance if the strength of the steel is to be developed, but is a matter of considerable difficulty from a practical point of view, especially with thin walls, as those who have built such structures are well aware. Though the practical difficulties might be solved by designing the steel with closely spaced vertical rods of large size, such a design, in most cases, would require considerably more steel than is really necessary.

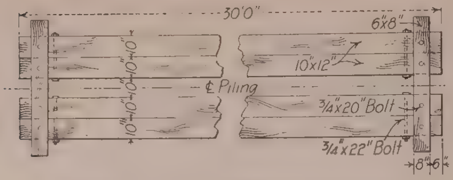
The concrete reservoir referred to, which was completed this year, is 32 ft. in diameter and 15 ft. deep. Wood forms were used. The outside forms and vertical steel rods were set first. Next, sixteen of the 2 x 4s mentioned, with the 20d. spikes, driven just through them at proper intervals in the flat side, were stood up around the outside of the circle to which the horizontal reinforcing was set, with the heads of the nails projecting inward. These uprights were then fastened securely to the outside form so that when the steel was placed on the spikes and against the 2 x 4s it was at the proper distance from the outer surface of the wall. After the horizontal steel had been properly fastened to the vertical rods, forming a stiff structure which had been erected in correct position before it was required to carry its own weight, the spikes were pulled from the inside of the reservoir and the 2 x 4s removed.

Rigid Guide Frame Holds Wood Sheet Piles

By C. LOUIS ZULL

Inspector, U. S. Engineer Office, Florence, Ind.

AN EXTRA-HEAVY and rigid frame, shown in the sketch, has saved time and given satisfactory results in driving with swinging leads the 10 x 12-in. wood sheeting required under the lock and guide walls at government dam 39 on the Ohio River. More than 3500 of these piles, from



STIFF RUNWAYS PREVENT TWISTING

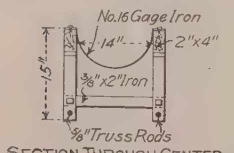
20 to 25 ft. long, are required for this part of the dam. Each pile is made by spiking to the 10-in. sides of a 10 x 12-in. timber a 3 x 4-in. tongue on one side and two 3 x 3-in. pieces to form a groove on the other.

The runway, the construction of which is shown in the sketch, was built with the center space exactly 10 in. wide, so that the stiffness of the construction would be developed to hold the piles from twisting out of line. In setting it, the cross-piece at one end rested in an 8-in. notch cut out between the last two piles driven. The other end was set to line, and braced securely on each side to prevent shifting. Twenty-two piles could be driven before the runway need be moved, so that, once set, it was good for 12 to 16 hours' driving. Moving required only about 20 minutes, the runway being handled with the pile line.

Dam 39 is being built by U. S. Government forces in charge of L. H. Prell, assistant engineer. Charles E. Hammell, junior engineer, is in charge of the inspection.

Emergency Chute Made Cheaply of 2 x 4s and Sheet Iron

CONFRONTED with the necessity for a substitute length of chute in the construction of a $250,000 building at Tacoma, and with 10 to 15 days required to order and receive a new length of steel chute, Mr. Pearson, superintendent for the contractors, built the wood-and-sheet-iron chute shown in the photograph for $35, and put it to work without delaying the job. As indicated in the sketch, the chute is made of No. 16 gage sheet iron bent to a semicircle and nailed at the sides to 2 x 4-in. pieces. The chute is 24 ft. long, and the center 14 ft. of this length is trussed with 5/8-in. rods secured to the 2 x 4s with brackets of 2-in. strap iron. The bottom section of sheet iron projects about 3 ft. beyond the end of the 2 x 4s, and a hopper 30 in. long and 10 in. high is built on the upper end. It is stated that the home-made chute cost about half the price, delivered to the job, of a manufactured chute of the same length.



SECTION THROUGH CENTER

The building in question, known as the Jones Block, is being erected by the Realty Construction Company of Tacoma.

WOOD AND SHEET-IRON CHUTE, BUILT ON THE JOB, SAVED TEN DAYS' DELAY

Bend Both Ends of Bar at Once on Rigid, Durable Bench

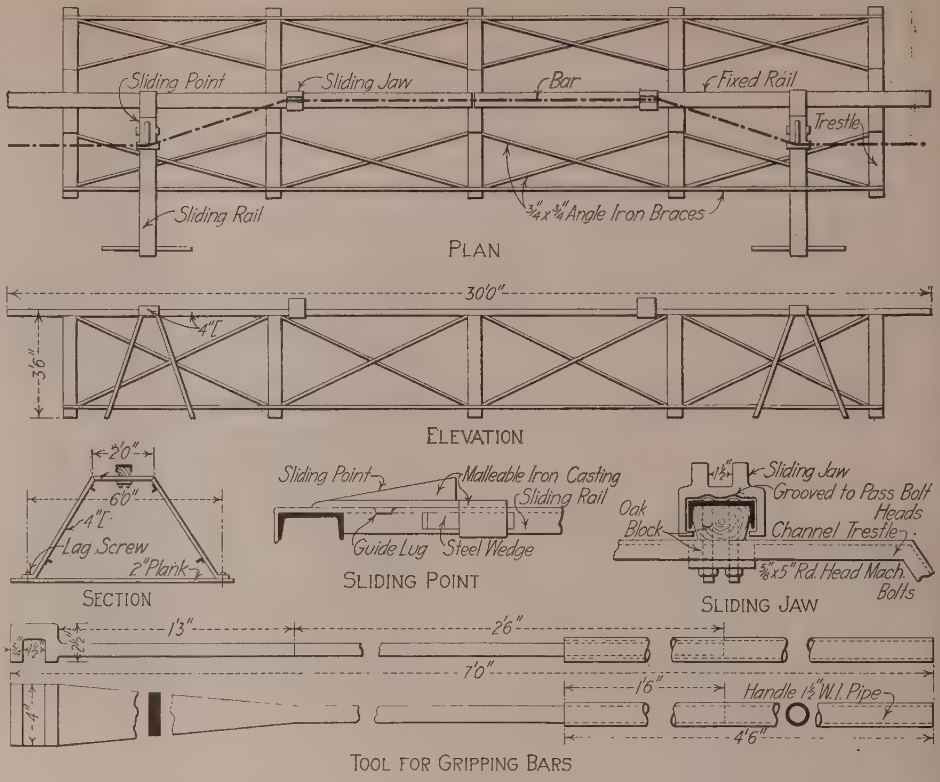
By GEORGE W. DAVIDSON
Providence, R. I.

A RIGID, durable steel bench which can be quickly set to make any sort of bends in reinforcing bars up to 1½ in. square, and on which both ends of a bar may be bent at the same time, was recently built by the writer while steel foreman on a reinforced-concrete contract, and has given satisfactory service on two consecutive jobs of this sort.

The main part of the machine is a 30-ft. fixed rail made of two 15-ft. lengths of 4-in. channel mounted on five angle-iron trestles. At right angles to this rail, and built, as shown in the details, so that they can be moved along it, are two sliding rails supported at their outer ends by angle legs. These also are made of channels. Between the two sliding rails on the fixed rails are mounted two movable jaws. On each of the movable rails is mounted a sliding point, which is used to gage the first bend and against which the second bend is made. A scale is marked on each of the three rails, so that the jaws, movable rails and points can be quickly set without the use of a rule to make a double bend ranging in offset from 3 in. to 4 ft. The bending tools shown in this sketch are used to afford sufficient leverage to make a sharp bend quickly. Plate washers are used in the jaws when bars of less than the maximum size are bent.

In using the machine a bar is laid in the two movable jaws. One man with a bending tool standing outside the bend grips the rod and bends it over past the movable point and a second man with another tool catches the rod beyond the movable point and bends it back against it. A large output can be obtained with the machine by using four men, bending both ends of the bar at once, and having extra laborers to supply and take away the bars.

The machine is rigid, durable and large enough for bending any steel ordinarily required. On the other hand, it is readily knocked down for shipment, and two men can erect it in an hour. Five men can move it around the job. With this machine two men can bend 1¼-in. square bars steadily without fatigue.



FOUR MEN CAN REACH LARGE OUTPUT DOUBLE-BENDING EACH END OF BAR AT SAME TIME

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Illinois Central Presents Electrification Plan

For Suburban Service in Chicago Within Next Five Years—Ordinance Submitted to Railway Terminal Commission

Electrification of the suburban service in Chicago by the Illinois Central Railroad within five years after the beginning of construction on its new terminal is a feature of the ordinance presented by the road Dec. 14 to the Railway Terminal Commission. The document contains the concessions asked of the city in the construction of the new terminal and extension of the railroad system upon shoreline property acquired from the South Park Commission in lieu of the company's surrender of its riparian rights.

The company asks permission to build a four-track subway in Grant Park between its present right-of-way and Michigan Avenue. This subway may be subject to joint use of any future traction subway system. The plans for the new passenger terminal include track facilities for the accommodation of all roads now entering the La Salle and the Dearborn stations.

Other Provisions of Ordinance

The ordinance also provides for the establishment by South Park commissioners of five bathing beaches between Twelfth and Fifty-first streets, and for the construction of the Eighteenth Street connection, bringing practically all of the railroads into communication with harbor district No. 3, between Sixteenth and Thirty-fifth streets. Indiana Avenue is to be widened to 100 ft. and extended diagonally across the block lying east of Michigan Avenue between Thirteenth and Twelfth streets, railroad property upon which the present station stands is to be dedicated as part of Grant Park, and the company is to be allowed to fill in five slips near Randolph Street and use ground for railroad purposes. The ordinance also says that disputes regarding terms of ordinance are to be settled by arbitration, and prior grants canceled and rights defined are to be granted in perpetuity.

Railroad's Point of View

In a statement emphasizing the railroad's point of view and benefits to the public, C. H. Markham, president, said that the proposed scheme of operation would eliminate 70 to 80 per cent of the switching and smoke from the downtown lakefront. "Location of the road on the lakefront always has been a liability and not an asset, as is generally believed, and the only way the company can be recompensed for surrender of its riparian rights along the lakefront, and in addition thereto surrender of the site for the Field Museum, the widening of Indiana Avenue and extension of Twelfth Street and Grant Park, will be in the securing of rights to use the new property acquired under contract with the South Park commissioners for purposes which will permit of arranging with other railroad companies to use its passenger terminal."

Open South Tube of East River Tunnel

The final blast in the south tube of the tunnel from Old Slip, in Manhattan, to Clark Street, Brooklyn, New York City, was fired last Tuesday morning. This tube is for the eastbound trains of the dual rapid-transit system, and, like its twin, the north tube, which was opened Nov. 28, will connect the Seventh Avenue subway with the first subway in Brooklyn.

Highway Officials Convene in St. Louis

Twenty-five States Represented—Think Expansion Joints in Concrete Roads Unnecessary —Maintenance Serious Question

The third annual meeting of the American Association of State Highway Officials was held Dec. 5, 6 and 7 at St. Louis, with representatives from twenty-five states in attendance. The federal-aid road bill, road-surfacing materials and their cost, maintenance of roads, highway legislation and bridge patents and recent decisions were among the subjects discussed. The interpretation by the Secretary of Agriculture of the federal-aid road bill, which had been drafted by the association, was given considerable prominence. While the officials were not in full accord with the interpretations of the secretary and with the rules and regulations that he promulgated for the operation of the bill, it was the consensus of opinion that this was co-operative work and that the state highway departments were ready to try the secretary's interpretation of the bill and his rules and regulations and do everything possible to make the act a success in furthering the construction of roads.

New Field for Use of Bitumen

In the discussion relating to surfacing materials information was given that indicated the opening up of a new field for the use of bitumen in road surfacing. This was in connection with the construction of sand-clay, topsoil and gravel roads, such as are being built so extensively throughout the South. Many officials stated that they did not consider it necessary to use expansion joints in concrete roads, but that the concrete after it was set would crack, and then these contraction cracks could be used as expansion joints.

One of the principal points brought out in discussing brick pavements was that while formerly it was considered necessary to lay the brick on a sand cushion, now the brick is laid in green cement, with better results. Photographs were exhibited of a working model of a paving machine used in laying pavements in the shops of the William Bayley Company, Springfield, Ohio. The device prepares the foundation for the brick, places the grout, shapes it, and lays either brick, asphalt blocks, wood blocks, or other form of block pavement.

It was shown that the question of maintenance of public roads is one of the most serious now confronting state highway departments. All agree that provision must be made for the maintenance of roads as fast as they are built.

When the subject of bridge patents and recent decisions was introduced, it was learned that many state highway departments have experienced considerable inconvenience and expense in regard to certain patents that have been awarded in connection with bridge designs. It was thought that some of these claims ought not to be patented. Among them were patents on straight or curved wing walls below the roadway level, protection apron projecting downward into bed of stream, horizontal projection depressed below pavement, spandrel or girder cantilevered on abutment, and claims in regard to re-alignment of coping formations.

The officers elected at this meeting for the ensuing year were: George P. Coleman, Richmond, Va., president; A. B. Fletcher, Sacramento, Cal., vice-president; Joseph Hyde Pratt, Chapel Hill, N. C., secretary; F. F. Rogers, Lansing, Mich., treasurer; W. D. Uhler, Harrisburg, Pa., chairman executive committee.

12,000 Snow-Fighters Prevent New York Traffic Tieup

Commissioner Fetherston Mobilizes Emergency Force at Quick Notice and Uses 102 Motor Snow Plows

New York City's snow-fighting system, which John T. Fetherston, street cleaning commissioner, has been perfecting for several years, met a severe test last week when it was called upon for the first time this season to clear away a 12-in. fall of snow occurring between 6 a. m. and 9 p. m. Friday, Dec. 15. A few hours after the first flakes had settled upon the city streets 12,000 emergency workers and regular street-cleaning department employees had been mobilized, and their efforts, reinforced by 102 motor-driven plows and the use of the municipal sewerage system as a means of snow disposal, succeeded in preventing any serious tieup of traffic, in spite of the unusual severity of the storm. The response to the call for emergency snow-fighters exceeded all expectations of street-cleaning department officials, for with the present condition of the labor market great difficulty had been anticipated in recruiting the force up to a strength sufficient to cope with a real storm. A strike of garment workers in New York, however, is believed to be responsible in part for the large turnout.

Emergency Men Called

The Weather Bureau notified the Department of Street Cleaning that a heavy snowfall could be expected on Dec. 15. At 9:25 a. m. the automobile snow plows of the snow-fighting force were ordered to start work. At 10 a. m. the snow-fighting force (emergency laborers and regular D. S. C. sweepers) began work in the various districts, and by 1 p. m. 12,000 men were at work clearing crosswalks and nearside car stops and sewering and piling snow, each gang in its appointed place with the necessary equipment of shovels, picks, pan scrapers, red flags, hose, etc. This first shift of laborers worked until 11 p. m. Friday, when a second shift was started, composed of 6000 emergency laborers and half the regular sweeping force, the latter acting as squad leaders. These 7500 men worked from 11 p. m. Friday until 8 a. m. Saturday.

One hundred and two 5-ton motor trucks, with snow plows attached, started work on Friday, and continued all day until 8 a. m. Saturday. On Saturday morning 1300 contractors' trucks and 1500 laborers started carting snow, and continued work all day Saturday.

Pay $36,000 in Silver

After the last snow-fighting shift, ending at 8 a. m. Saturday, 5320 emergency laborers and 1500 sweepers continued snow work, sewering and piling until 5 p. m. Saturday, when payment to 12,000 snow-fighters, who worked Friday and up to 8 a. m. Saturday, was started and finished by 8 p. m. This is said to establish a new record for prompt payment of emergency laborers by municipalities, where the usual red tape of making out, certifying and auditing payrolls must be complied with. The men were paid at 106 different points in Manhattan, The Bronx and Brooklyn, and as the banks closed at 12 o'clock Saturday it was necessary to secure money promptly. More than $36,000 was paid in silver, as no bills were procurable.

Work continued Saturday night in the downtown section of Manhattan only, where 200 contractors' trucks and 400 laborers worked.

On Sunday morning every possible force was put to work on the snow job, including all regular employees of the street cleaning department and as many emergency laborers as could be secured. The total force on Sunday amounted to 10,000 laborers and sweepers and 3610 vehicles.

The total depth of snowfall given by the Weather Bureau amounted to 12 in. The snowfall started about 6 a. m. on Friday, Dec. 15, and continued falling heavily until about 9 p. m., then intermittently until 2 a. m. Saturday.

By Saturday morning, according to the department records, all main arteries had been plowed and the snow piled so that traffic moved freely. Most of the side streets had been either plowed or piled. By 6 p. m. Sunday most of the snow was removed from the main arteries and important crosstown streets. The total area scheduled for snow work is over 30,000,000 sq. yd., equivalent to a roadway 60 ft. wide reaching from New York to Chicago (950 miles).

The surprising fact developed in the snow-fighting force was that 9000 men reported for work without special notice on the part of the Police Department, and very few of these men had registered in advance of the snow job. Just where the men came from is not at all certain, but there is a garment workers' strike on in New York, and possibly a great many of the garment workers applied for snow jobs. The City College, Columbia University and New York University were requested to send students. Some of the students volunteered to shovel snow, but the number who actually did work is not known at this time.

Snow-fighters are paid 30 cents an hour. After the storm is over, when emergency labor is employed, the men are paid 25 cents an hour. Each shift runs for 9 hours, and 4 hours are allowed for the first shift to get under way. Thus, men on the first shift may work 13 hours, if they report at the station at the time the call is sent out.

Highway Conference January 29 to February 3 at Pittsburgh

The Pennsylvania State Highway Department will again co-operate with the University of Pittsburgh in offering a conference on highway construction and maintenance in Thaw Hall, University of Pittsburgh, from Jan. 29 to Feb. 3 inclusive. While the course is intended to be a continuation of the subjects discussed at last year's short course in highway engineering, the conferences will be so arranged that those not present last year may take up the work with those who attended. The leaders in the discussion of the various subjects will be selected from the state highway department officials, school of engineering faculty and others.

A new building for housing the laboratory for testing highway materials, now in process of erection, will be completed in time for use during the conference. Those desiring tests of materials should send their samples to Professor L. C. McCandliss not later than Jan. 15. No charge will be made for tests to those attending the conference. A registration fee of $5 is charged.

American Waterworks Association Convenes in Richmond Next May

The thirty-seventh annual convention of the American Waterworks Association will be held at the Jefferson Hotel, Richmond, Va., May 7 to 11, according to an announcement just issued by President Leonard Metcalf. Several important committees will report at this meeting, among them those on electrolysis, water consumption and private fire protection. Some important changes in the constitution also will be considered. The executive board urges members to send at once to the secretary suggestions for papers or topics for discussion. It is planned to devote at least three full sessions to "Superintendents' Day" if the superintendents will provide the material to fill the time. The nominating committee has selected the following candidates for offices in the association during the ensuing year: President, Theodore A. Leisen, general superintendent, Board of Water Commissioners, Detroit, Mich.; vice-president, Charles R. Henderson, Davenport, Iowa; treasurer, John C. Trautwine, Jr., civil engineer, Philadelphia; trustees, Beekman C. Little, superintendent of waterworks, Rochester, N. Y., and Henry B. Morgan, manager, waterworks company, Peoria, Ill. Additional nominations, indorsed by twenty-five members, may be made up to Feb. 7, 1917.

Illinois Commission Adopts New Rule for Examining Highway Engineers

Because the old ruling made it necessary for applicants to go to the expense of coming to Illinois to be examined, which resulted in few applications from engineers outside of the state, the Civil Service Commission of Illinois has adopted a new plan for examining applicants for positions as junior highway engineers. Under the new arrangement, unassembled examinations will be made and the applicants will mail their papers to Springfield.

The first examination under the new ruling will be held Feb. 3. It is open to all citizens of the United States. The salary is $75 to $120 a month.

Seattle Engineering Societies Consolidate

The consolidation of the six engineering societies of Seattle was recently announced by John L. Hall, temporary president of the Associated Engineering Societies of that city. The joint council of the organization met Dec. 9 and effected a permanent organization. The object of the consolidation is to promote the welfare of engineers and engineering and of the public as affected by engineering matters. The various organizations will not lose their individuality, but the members of each society will be members of the Associated Engineering Society. Represented in the newly organized society are the Pacific Northwest Society of Engineering, Washington Association of Engineers, Seattle Association of Members of the American Society of Civil Engineers, Puget Sound section of the American Institute of Mining Engineers, Seattle section of the American Institute of Electrical Engineers and the Puget Sound section of the American Chemical Society.

Meetings will be held at stated intervals, public problems discussed and technical papers read, looking toward the betterment and advancement of the engineering profession. Quarters will be engaged for a library of technical literature and for a meeting place.

Announce Nominees for Railway Engineering Association

John G. Sullivan, chief engineer of the Western Lines of the Canadian Pacific Railway, has been announced as nominee for president of the American Railway Engineering Association for the coming year. Earl Stimson, engineer maintenance of way of the Baltimore & Ohio Railroad, is nominated for vice-president. George H. Bremner and E. H. Fritch are renominated for treasurer and secretary respectively.

Three directors are to be chosen from the following nine nominees: J. A. Atwood, Pittsburgh & Lake Erie; Hadley Baldwin, Cleveland, Cincinnati, Chicago & St. Louis; W. H. Courtenay, Louisville & Nashville; L. A. Downs, Illinois Central; S. B. Fisher, Missouri, Kansas & Texas; H. E. Hale, Presidents' Conference Committee; John D. Isaacs, Southern Pacific; E. H. Lee, Chicago & Western Indiana, and E. B. Temple, Pennsylvania.

Five members of the nominating committee are to be selected from these ten candidates: J. R. W. Ambrose, Toronto Terminals; George H. Burgess, Delaware & Hudson; W. M. Dawley, Erie; V. K. Hendricks, St. Louis & San Francisco; W. T. Dorrance, New York, New Haven & Hartford; B. H. Mann, Missouri Pacific; J. A. Peabody, Chicago & North Western; S. T. Wagner, Philadelphia & Reading; C. A. Wilson, consulting engineer, and H. S. Wilgus, Pittsburgh, Shawmut & Northern.

Engineers Will Take Most Prominent Place After the War

The important position in the life of the United States which will be occupied by the engineers of the future was the subject of the address by Newton D. Baker, Secretary of War, at the Washington Society of Engineers' annual banquet in Washington, Tuesday evening, Dec. 5. The part engineers are going to play in the making of the new civilization probably is more important than that of any other profession, said Mr. Baker. In the industrial and commercial undertakings in the next eight or twelve years, engineers are going to be a vastly important factor, Mr. Baker believes.

"We of America must meet the Europe which, after the war, will be working with might and main for common good," he continued. "The engineer is going to take his place alongside of the politician in making possible the vast extension of activity in our country. I find in my observations in the War Department that war is becoming more dependent on engineering than on the contributions of any other science. This government is fortunate in that it has always had a great corps of engineers of all kinds who now can be mobilized in preparation for a new era."

Long Sault Development Loses in Supreme Court

The United States Supreme Court recently held that the decision of the Court of Appeals in the Long Sault Development Company's case presented no question for decision under the Federal Constitution, and for want of jurisdiction dismissed the writ of error. This action was brought by the Long Sault Development Company, to which the Legislature of New York in 1907 granted rights to the use of the bed of the St. Lawrence River, subject to approval by Congress, against John J. Kennedy and later against Homer D. Call, as treasurer of the state.

The Court of Appeals held that the legislature had no power to grant to the development company the right to the land under a navigable stream to which the people of the state had a right of ownership for any possible public use.

Community Activated-Sludge Plant for Chicago Stockyards

Engineers of the stockyards interests and the Sanitary District of Chicago, after making a joint study of the proper disposal system, agree that the activated-sludge method will handle the sewage in a manner which will produce an effluent suitable to discharge into the main channel of the district. They also conclude that a community plant to take care of all the wastes from all the packing industries is better than the disposal by each company of its own wastes. The second question put to the engineers was as to the works, expenditures, appliances for collection and disposal, location, cost of installation, repair maintenance, operation and revenue that might be expected. A preliminary report states that, having concluded that activated sludge will do the work, effort is now being directed toward answering the second set of questions. Langdon Pearse represents the Sanitary District of Chicago and W. D. Richardson the packers.

Two Highway Engineering Sessions Next Week in New York City

It has been decided to hold two joint meetings Dec. 28, to discuss highway engineering, in the assembly hall of the Automobile Club of America, New York City. These sessions are being promoted by Engineering Section D of the American Association for the Advancement of Science, which organization convenes Dec. 26 to 30. The first session, at 2 p. m., will be devoted to a consideration of road subjects to be included in the civil engineering curricula of universities and colleges. At the second session, beginning at 8 p. m., research papers in various fields of highway engineering will be presented, including several pertaining to the use of motor trucks and their relation to highway construction.

Popularizing the Water Department

Giving free samples of its product in every variety is a part of the policy of the water department of Hope, Ark., as evidenced by the picture. The well shown was installed by the municipal department, which controls the central station and the waterworks. The faucet on the left gives fresh water from a 500-ft. level, that in the center from a 1480-ft. depth and the one on the right supplies mineral water from 2685 ft. below the surface. The arrangement is said to be extremely popular with the townspeople.

FAUCETS ARRANGED TO GIVE RESIDENTS CHOICE OF WATER FROM THREE DIFFERENT LEVELS

Engineers to Lay Out Motor-Truck Routes in Cleveland

Residents of certain districts in Cleveland have complained so much about the annoyance and damage to light pavements that the city council has ordered the commissioner of engineering, in making plans for the expenditure of $3,000,000 for a repaving program recently voted, to consider the question of laying out routes to which drivers of motor trucks will be required to confine themselves. A request was also made for a report on the advisability of legislation which will restrict commercial motor trucks to certain routes, except in cases where they are required to deliver material upon residence streets.

Engineering Society Activities

Engineers' Society of Western Pennsylvania held its annual banquet recently at the William Penn Hotel, Pittsburgh. Among the speakers were Major-General George W. Goethals, who told about the construction of the canal and its relation to the extension of America's commercial interests, and William L. Saunders of New York, ex-president of the American Institute of Mining Engineers, who spoke on "The Engineer in Civic Life." More than 1100 were present at the largest banquet in the society's history.

Engineering Association of the South has plans under way for disbanding. The various sections will probably continue as local societies. The Nashville section has already begun organizing its members into the Nashville Engineering Society.

Idaho Society of Engineers will hold the seventh annual convention Jan. 18, 19 and 20 in Boise in conjunction with the conference of the operation and maintenance engineers of the U. S. Reclamation Service, to be held Jan. 16, 17 and 18. The program is not yet available.

Illinois Association of Members of the American Society of Civil Engineers at the Dec. 11 meeting elected the following officers: President, C. F. Loweth; vice-presidents, A. N. Talbot and A. S. Baldwin; secretary-treasurer, E. N. Layfield, secretary Western Society of Engineers. The executive committee was asked to take under advisement the proposition of increasing the activities of the association along technical and social lines, both of which heretofore have been left entirely to the Western Society of Engineers.

Providence Engineering Society has added 300 new members. Frederick H. Newell, professor of civil engineering at the University of Illinois, will address the society Dec. 27. The subject of his paper will be "Home Making in the Arid West." He will show slides of work the Reclamation Service has been and is now doing.

San Diego Branch of the American Society of Civil Engineers at the annual meeting held in that city on Dec. 1 elected the following officers: President, W. J. Gough; vice-president, W. S. Post; secretary-treasurer, J. R. Comly. Following the election an illustrated lecture on the "Development and Construction of Water Systems" was given by H. N. Savage, consulting engineer for the Sweetwater Water Company.

What Engineers and Contractors Are Doing

H. W. Lewis, who had charge of concrete jetty construction on the Shark River at Belmar, N. J., has resigned to enter the employ of Westinghouse Church Kerr & Company. Mr. Lewis will go to Matanzas, Cuba, to build a masonry dock and sea wall.

J. H. Byrd, formerly with Smith, Rea & Leavitt, architects, of Kansas City, has been made secretary-treasurer of the Collapsible Joint Form Company, of that city. The firm has just been incorporated and has headquarters in the Finance Building.

Harry H. Schoen, who has been in the employ of the Interstate Commerce Commission, Division of Valuation, for the last 2½ years, has resigned. He is now employed by the engineering department of the Minnesota & Ontario Power Company, of International Falls, Minn. Mr. Schoen is a graduate of Rensselaer Polytechnic Institute, class of 1911. Before his employment by the Interstate Commerce commission he was with the Boston & Maine Railroad for 3 years.

John Edwards, Jr., was recently appointed assistant supervisor of the Connellsville division of the Baltimore & Ohio Railroad, with office at Meyersdale, Pa. He first entered the employ of the Baltimore & Ohio in 1912. The next year he joined the U. S. Forest Service and in 1914 went to Washington to work in the district engineer's office. Mr. Edwards was appointed junior civil engineer for the Interstate Commerce Commission in 1915, which position he has left to return to the Baltimore & Ohio.

S. L. Tolman has left the employ of Post & McCord of New York City to go to the Caefer Construction Company at Holyoke, Mass.

C. B. Freeman, for the last seven years chief engineer for the William P. Carmichael and the Carmichael-Cryder companies, of St. Louis, will on Jan. 1 become chief engineer of the Walter S. Newhall Company, of Cleveland. His headquarters will be in Detroit.

Henry L. Collier, who opened consulting engineering offices in Atlanta, Ga., last year, will on Jan. 1 become chief of construction of that city. Mr. Collier has for many years been active in Atlanta engineering undertakings. He was recently consulting engineer for the Yellow Pine Manufacturers' Association.

S. J. Maas, assistant office engineer in charge of the computing section of the valuation committee of the Missouri, Kansas & Texas Railway, with headquarters at Parsons, Kan., has resigned to become resident engineer of the Galveston, Houston & Henderson Railroad, with office at Galveston. Mr. Maas succeeds Mr. F. W. Bailey.

F. W. Bailey, superintendent of bridges and buildings for the Missouri, Kansas & Texas Railway from 1905 to 1911, has resigned to go to the San Antonio & Aransas Pass Railroad as engineer maintenance of way, with headquarters at San Antonio.

F. E. Wilmot, who has been in the service of the Philippine government since 1911, is in the United States on a vacation. He is at present located at Los Angeles and expects to remain in this country until next March.

E. L. Crugar, formerly assistant engineer for the Illinois Central Railroad at Chicago, has been made district engineer at New Orleans. He succeeds C. E. Weaver, who was recently appointed engineer maintenance of way for the Central of Georgia Railway.

C. R. Harding, formerly chief draftsman for the consulting engineer of the Southern Pacific system, is now assistant to the consulting engineer of the New York Central Railroad.

J. H. Schuch has been made chief engineer of the Butte, Anaconda & Pacific Railway to succeed Charles A. Lemmon.

Roscoe L. Smith has resigned as principal assistant engineer of the St. Paul water department, effective Dec. 15. He is a graduate of Lafayette College of Engineering, class of 1908, and has spent the last 4½ years in the position from which he has just resigned. Mr. Smith has announced no plans for the future.

Frank M. Wilson of Trenton has been appointed borough engineer of Hopewell, N. J.

Morse W. Rew has resigned as assistant engineer of the Cincinnati Rapid Transit Commission to take a position as assistant to E. K. Morse, transit commissioner of Pittsburgh. Mr. Rew's successor has not yet been announced.

Roscoe Sawistowsky was recently elected city engineer of Davenport, Iowa.

Victor Cotner, who recently formed a partnership with D. T. Cotner and opened consulting engineering offices at Lovell, Wyo., has charge of three drainage projects and also directs the engineering work of that city. The drainage work includes one project at Cowley, another at Lovell and two proposed undertakings at Worland and at Lovell. Victor Cotner has been engaged on engineering work in the West since 1912.

J. A. GRENIER has resigned as assistant chief engineer of the Bollinger-Andrews Construction Company to become chief engineer of the Andrews Construction Company, Pittsburgh.

GEORGE S. RICE, chief engineer of the U. S. Bureau of Mines, Washington, has been engaged by the province of British Columbia to make an investigation of the Coal Creek coal areas of the Crows Nest Pass Coal Company. He will attempt to ascertain the causes of accidents which have caused many deaths.

FREDERIC V. PITNEY, hydraulic engineer, of Dover, N. J., has been engaged by the local board of water commissioners to arrange for an additional water supply for the city.

J. E. JOHNSON, who has been connected with the engineering department of Illinois since 1912, has resigned to become county superintendent of highways at Princeton, Ill. He will succeed F. R. Bryant, whose resignation becomes effective in February. Mr. Johnson was graduated from Swarthmore College in 1910. His first work was in the construction department of the Pennsylvania Railroad. The following year-and-a-half were spent with the Bell Telephone Company. Mr. Johnson went to Illinois in 1912 and has been employed as inspector of bridges and concrete roads for the state ever since. He superintended the construction of the Marquette Hill and Shippingsport roads near La Salle and also had charge of laying out and building the permanent roads at Starved Rock State Park. He had charge of construction of the monolithic state-aid road at Seneca.

Obituary Notes

THOMAS ELWOOD CALVERT, chief engineer of the Chicago, Burlington & Quincy Railroad, died Dec. 19 at his home near Lincoln, Neb., at the age of 67. Mr. Calvert's engineering experience had been entirely with the railroad which he served forty-five years. He was born near Philadelphia in 1849 and was graduated from Yale University in 1870. The following year he entered the service of the engineering department of the Chicago, Burlington & Quincy. His promotion to the superintendency of the lines west of the Missouri River came in 1875. In 1905 he was made chief engineer.

WILLIAM C. NIXON, president of the St. Louis & San Francisco Railroad, died Dec. 15 in St. Louis in his fifty-ninth year. Mr. Nixon worked his way up from the position of a day laborer. He was born in Earlville, Ill., and began work in 1878 as a bridge carpenter on the Burlington & Missouri Railroad in Nebraska.

Civil Service Examinations

New York—Examinations will be held Jan. 27 for junior assistant in engineering departments, salary $901 to $1,200.

United States—Examinations will be held Jan. 17 and 18 for surveyor, salary $100 to $150 a month and subsistence, and mechanical draftsman, salary $1,000. Forms 1312 and 304 respectively should be filled in by applicants. Examination will be held Jan. 23 for senior structural engineer, salary $3,000 to $4,000 a year. Fill in form 2039. Another examination to be held Jan. 23 is for architectural draftsman, salary $130 a month. Ask for form 2118.

Examinations Previously Announced

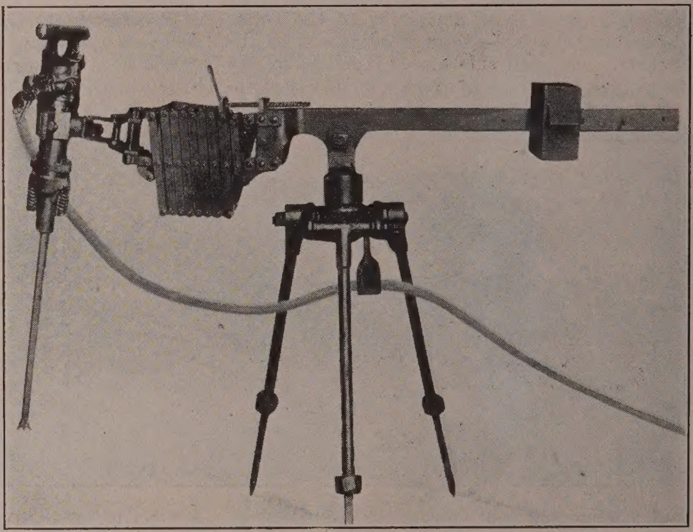
Date		See Eng. Record
Jan. 3.	Transitman, United States	Dec. 16
Jan. 3.	Examiner of surveys	Dec. 16
Jan. 3.	Geologic aid	Dec. 16
Jan. 9.	Draftsman, United States	Dec. 16

Should Burn Dynamite Boxes

Owing to the possibility of nitroglycerin leakage of dynamite, due to improper storage, there is danger in making any use of an empty dynamite box, according to E. I. du Pont de Nemours & Company, and all explosive dealers should be instructed to destroy such boxes after demonstrations. The boxes should be burned without being knocked to pieces or split, as wood that has absorbed nitroglycerin is explosive.

Counterbalanced Toolholder Has Flexible Extension Arm

By employing the easy-jack principle to the extension arm of a counterbalanced toolholder, greatly increased range of operation of portable tools to 16 ft. has been obtained. The holder illustrated has been tried out for some time on various pieces of construction for which George W. Jackson has been contractor. From experience gained in this work the maker, the Jackson, Schmitz & Shanks Engineering Company, Chicago, makes the following comments: "Where portable tools have to be held to the work by one or more men, it is beyond their strength to get 100 per cent efficiency. With the toolholder the workman is relieved of the weight and shock of the tool and can direct his energy to guiding it. The type shown, mounted on a tripod or on a truck, will take tools weighing from 20 to 150 lb." Some suggested uses are pneumatic riveting, chipping, busting, blacksmithing, holding jack hammers, drills, tamping tools, electric grinders and drills and coal cutters, tools for cutting pavement, breaking concrete and frozen ground, tamping ground and driving sheeting.



EASY JACK EXTENSION GIVES TOOLHOLDER 16-FOOT RANGE AND IS SAID TO RELIEVE WORKMAN OF WEIGHT AND SHOCK OF TOOL

Auto Trailers Band Together

The Trailer Manufacturers' Association of America, formed by automobile trailer manufacturers at a recent meeting at Detroit, plans to conduct a publicity campaign to stimulate the use of trailers. George B. Russel of the Russel Motor Axle Company of Detroit, told of the good results of the campaign of the Internal Gear Drive Association. The trailer men decided to leave the details of an advertising campaign to the executive committee, made up of the following: A. C. Geiger, president Troy Wagon Works, Troy, Ohio, president; Miss Kate Gleason, secretary, Rochester (N. Y.) Trailer Company, vice-president; A. P. Warner, Warner Manufacturing Company, Beloit, Wis., vice-president; J. C. Endebrock, Sechler & Company, Cincinnati, secretary-treasurer; S. A. Griggs, Detroit Trailer Company; A. A. Keesler, president Watson Wagon Company, Canastota, N. Y., and James E. Britton, Rogers Brothers Company, Albion, Pa.

Galvanized Wire Mesh with Felt Used as Light Reinforcing

Galvanized wire mesh combined with tarred felt is a new product of the Clinton (Mass.) Wire Cloth Company. "Welded sheathing" is used as a support for plastering and as a light reinforcement for concrete floors and roofs. It is essentially a light grade of Clinton electrically welded wire fabric provided with a tarred felt backing, manufactured by arranging longitudinal and transverse wires on opposite sides of a sheet of tarred felt and electrically welding them together through very small holes previously punched in the felt at each point where a longitudinal wire crosses a transverse wire. In this way the tarred felt becomes an integral part of the wire mesh, and is securely locked and held between the two groups of wires. At the same time the felt has no physical connection to any of the wires. The longitudinal, or so-called carrying, wires are all arranged on the side of the felt to which the plaster or cement mortar is applied. Thus they are entirely unobstructed and become thoroughly embedded in the body of the plaster as the felt bulges slightly away from the wires under pressure of the plasterer's trowel.

Trade Publications

The following companies have recently issued trade literature:

Osgood Company, Marion, Ohio. Circulars 14 and 18 describing excavating machinery. Illustrations show uses.

A. Leschen & Sons Rope Company, St. Louis. Catalog 35, 3½ x 6 in., 94 pages, illustrated. Tables and data on wire rope and aerial wire rope tramways.

Blaw Steel Construction Company, Pittsburgh. Catalog 16, 6 x 9 in., 128 pages and cover, illustrated. Pictures show adaptability of Blawforms for all kinds of concrete work. Well presented and contains information on and pictures of many big jobs in the United States. Divided into chapters, each devoted to one kind of work.

Bucyrus Company, South Milwaukee. General catalog 15, 6 x 9 in., 40 pages, illustrated. Excavating, levee-building, pile-driving and unloading machinery.

Templeton Kenley & Company, Chicago. Catalog describing jack for straightening and pulling poles.

Lowell Wrench Company, Worcester, Mass. Catalog of reversible ratchet wrenches.

Avery Company, Peoria, Ill. Catalog, 8 x 11 in., 80 pages, illustrated. Tractors and steam engines.

Ideal Concrete Machinery Company, Cincinnati. Catalog 27, devoted to concrete mixers.